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FINAL REPORT

On

EVALUATION OF FABRIC FILTER AS CHEMICAL CONTACTOR FOR CONTROL OF SULFUR DIOXIDE FROM FLUE GAS

CONTRACT NO. PH22-68-51

THE AIR PREHEATER COMPANY, INC.

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For

Department of Health, Education, and Welfare
Public Health Service
National Air Pollution Control Administration
Durham, North Carolina 27701

By

Han Liu

Robert Chaffee

Air Preheater Company, Incorporated
Division of Combustion Engineering, Incorporated
Wellsville, New York 14895

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INTRODUCTION

This study, conducted under contract No. PH22-68-51, of the National Air Pollution Control Administration, was to investigate the potential of the top-inlet fabric filterhouse as a chemical contactor for the removal of sulfur dioxide from flue gas.

The first phase of the program was to evaluate the feasibility of the filterhouse to be used as a chemical contactor for SO_2 removal using sodium bicarbonate as the sorbent material. The sorbent was injected into the flue gas stream. It reacted with the SO_2 in the flue gas while suspended in the gas stream and on the filter bags. The SO_2 concentration of the flue gas before and after the filterhouse was continuously monitored for determination of the degree of SO_2 removal. Process variables such as sorbent feeding rate, gas temperature, filter ratio, filterhouse operation modes, sorbent feeding methods and retention time were all observed and studied.

The second phase of the program was carried out investigating process variables at higher temperatures and with sorbent materials other than sodium bicarbonate, namely, nahcolite which is a mineral containing about 70% sodium bicarbonate and three different types of hydrated lime.

This final report covers work done on the entire program, including both phases, during the period June 20, 1968, through December 31, 1969.

SUMMARY

Experimental Results-

The sorption of SO_2 by sodium bicarbonate, nahcolite, hydrated dolomitic lime, promoted hydrated dolomitic lime, and hydrated lime was studied using a full scale pilot fabric filterhouse as the chemical contactor under various operating conditions. The test facility was the pilot filterhouse installed at the Mercer Generating Station of Public Service Electric and Gas Company of New Jersey, Trenton, New Jersey.

A total of 62 tests was performed to determine the effects of sorbent stoichiometric ratio, operating temperature, flue gas flow rate (filter ratio), mode of house operation, method of sorbent feeding and sorbent retention time. For the experiments conducted, gas temperatures ranged between 270°F and 640°F; flow rates between 7,500 ACFM and 15,000 ACFM; sorbent to SO_2 stoichiometric ratios from 0.75 to 3.4 and sorbent retention time from 2.5 seconds to 6 seconds. In addition to the measurements of SO_2 concentration and all the operating parameters, the mixture of the sorbent and flyash collected at the bottom of the filterhouse hopper was also sampled and analyzed. This was carried out

Tests were also conducted

in an attempt to determine how much of the SO_2 removal was taking place while the sorbent was in suspension and how much was taking place in the filtercake on the bags. over

In general, sodium bicarbonate and nahcolite reacted similarly but considerably differently from the hydrated limes. At higher temperature, near the sodium bicarbonate decomposition point, 518°F, the highest achieved SO_2 conversion efficiency was 98.4% with a stoichiometric ratio of 2. Similarly for nahcolite the highest conversion efficiency was 96.2% with a stoichiometric ratio of 1.2; and for dolomitic lime the highest was 48.6% with a stoichiometric ratio of 3 at 640°F. The percent of the total SO_2 removal taking place in the from page 2

gas stream before deposit of the sorbent on the filterbags with sodium bicarbonate and nahcolite was different from that with the hydrated limes. The major part of SO_2 removal with sodium bicarbonate and nahcolite took place on the bags at medium temperatures while the major SO_2 removal for the hydrated limes took place while the lime was in suspension in the gas stream. The observations on the relative amounts of SO_2 removal taking place in the gas stream and on the bags are based on limited data and requires further tests for substantiation.

Measurements of NO_2 were also made during the tests. The highest achieved $NO2$ reduction was about 42% while the SO_2 conversion was 91% with nahcolite at 350°F. This result suggests that the goal of the investigation of the potential of the filterhouse may be enlarged to cover the control of both SO_2 and $NO2$.

Conclusions, Discussion, and Recommendation:

1) Conclusions -

The following conclusions of significance may be derived from analysis of the test results:

(i) It ~~is~~ was definitely shown that the fabric filter can perform adequately as an effective chemical contactor for removal of SO_2 from the flue gas as well as a control device for flyash.

(ii) Of the various filterhouse operating parameters tested, the operating temperature and the stoichiometric ratio have the strongest effect on SO_2 conversion efficiency. Increased SO_2 conversion efficiency results from an increase in temperature or stoichiometric ratio.

(iii) The percent of SO_2 removal taking place in the gas stream before deposit of the sorbent on the filter bag is strongly influenced by the operating temperature range and by the characteristics of the specific sorbent used for these tests.

Average values of significance illustrating the conclusions discussed above may be approximately derived from analyses of the individual tests and are summarized in the following table. The values given for the percent conversion taking place in the gas stream were based on limited data and should be used only as rough estimates of the actual level.

	Stoich. Ratio = 1			Stoich. Ratio = 3		
Additive	Conv. Eff.* %	Util. Eff.* %	Conv. In Gas* %	Conv. Eff. %	Util. Eff. %	Conv. In Gas %
Sodium Bicarbonate - 270°F	32	32	--	48	16	12
Sodium Bicarbonate - 350°F	48	48	26	76	26	12
Sodium Bicarbonate - 600°F	90	90	72	--	--	--
Nahcolite - 350°F	65	65	11	85	30	24
Nahcolite - 600°F	94	94	60	--	--	--
Hydrated Dolomite Lime - 350°F	--	--	--	20	7	75
Hydrated Dolomite Lime - 600°F	20	20	95	38	13	80

*The nomenclatures used in this table are defined in the "Test Procedure" section. They are:
Conv. Eff. = SO_2 Conversion Efficiency
Util. Eff. = Additive Utilization Effectiveness
Conv. in Gas = SO_2 Conversion in the gas stream or in suspension.

Effects of other operating parameters may be observed as follows:

(i) Filter ratio, or face velocity at the filter bags, has a negative effect on SO_2 conversion efficiency for cases using sodium bicarbonate and nahcolite and a slight positive effect using hydrated dolomitic lime.

(ii) The specific filtercake resistance appears to be a strong function of filter ratio for a specific set of filter material and working conditions.

(iii) Effects of other operating parameters were observed and analyzed in each individual section. Because of the complex effects on the design and system operation, no general conclusions could be made without further systematic optimization studies.

2) Discussion -

Results obtained during the current program have indicated that, when sorbent particles are injected into the flue gas, the following factors become important:

(i) It is highly desirable that the nature of the physical and chemical processes of the gas-solid system under various operating conditions is thoroughly understood so that valid extrapolations and design preferences can be logically made.

(ii) The sorbent material after reaction with SO_2 will become a new solid waste in addition to the flyash from the flue gas. Hence, the practicality of the SO_2 control system is dependent upon the economics of the overall waste disposal practice. Development of a sorbent which can be regenerated would greatly reduce this problem.

It may be of interest to consider the following simple calculation: According to the stoichiometric reactions of pure $NaHCO_3$ and $Ca(OH)_2$ with SO_2, we can write the following:

$$2NaHCO_3 + SO_2 + 1/2 \ O_2 \rightarrow Na_2SO_4 + H_2O + 2CO_2$$

$$Ca(OH)_2 + SO_2 + 1/2 \ O_2 \rightarrow CaSO_4 + H_2O$$

For a stoichiometric ratio of N, the amounts of sorbents required to react with one mol of sulfur are simply,

$NaHCO_3$: $W = N(2)(84.02)/(32) = 5.25N$

$Ca(OH)_2$: $W = N(74.1)/(32) = 2.32N$

The required sorbent to remove all the sulfur from the flue gas, or for a 100% SO_2 conversion efficiency, can be readily calculated. On the basis of tons of sorbent per 1000 tons of coal, it may be observed in the following table:

	2% - S - Coal			3% - S - Coal			4% - S - Coal		
	Stoich. Ratios			Stoich. Ratios			Stoich. Ratios		
Sorbent	1	2	3	1	2	3	1	2	3
$NaHCO_3$	105.0	210.0	315.0	157.5	315.0	472.5	210.0	420.0	630.0
$Ca(OH)_2$	46.4	92.8	139.2	69.6	139.2	208.8	92.8	185.6	278.4

It is obvious that the solid waste disposal problem is much more severe than that of the flyash when the actual required SO_2 conversion efficiency and the inert portion of the sorbent material are being considered.

3) **Recommendations** -

The following recommendations are outlined as a program to further develop the technology for application of the fabric filter baghouse as a chemical contactor for removal of gaseous pollutants from power plant flue gas and other industrial stack gases.

(i) Experimental studies on the optimization of the operating parameters for the gas-solid system using a fabric filter as the contactor.

(ii) Analytical and experimental studies on the dynamics of the gas-solid system in the fabric filterhouse.

(iii) Analytical and experimental studies on the chemical process of the selected sorbent-SO_2 systems at practical temperature ranges for filterhouse operations.

(iv) A search for fabric material of high temperature and acid resistance.

(v) A search for new sorbent materials which can be regenerated.

(vi) Experimental studies on the control of nitrogen oxides using the fabric filterhouse as the contactor.

(vii) A search for potential applications of the fabric filter as a chemical contactor to remove gaseous pollutants such as F_2, Cl_2, and HCl from industrial stack gases.

EXPERIMENTAL DETAILS

I. TEST FACILITY:

A) Filterhouse -

The tests were performed on the Air Preheater Pilot Filterhouse facility located at the Mercer Generating Station of Public Service Electric & Gas Company New Jersey in Trenton, New Jersey.

The facility was originally designed and built by Air Preheater Co. in 1965 for the purpose of evaluating the filterhouse as a means of fly ash control for utility applications.

Some major modifications were made on the facility in order to meet the operational requirements for these tests. As a contribution to this research effort; the Air Preheater Co. absorbed all the costs of engineering, material purchases and all the miscellaneous work of the modification effort except that of the field labor which is contributed by the Public Service Electric & Gas Co. of New Jersey.

The pilot filterhouse is of a top-entry design consisting of four (4) compartments, each containing nine (9) bags, 11-1/2" in diameter and 40' long with a total filter surface area of 4,300 sq.ft.

Figure 1 shows a system schematic of the Pilot Filterhouse facility. Major modifications on the facility are described in the subsequent sections.

B) Additive Feed System -

1. **Physical System & Feeding Site** - Since the original additive feed system was designed and built for a limited usage for the original

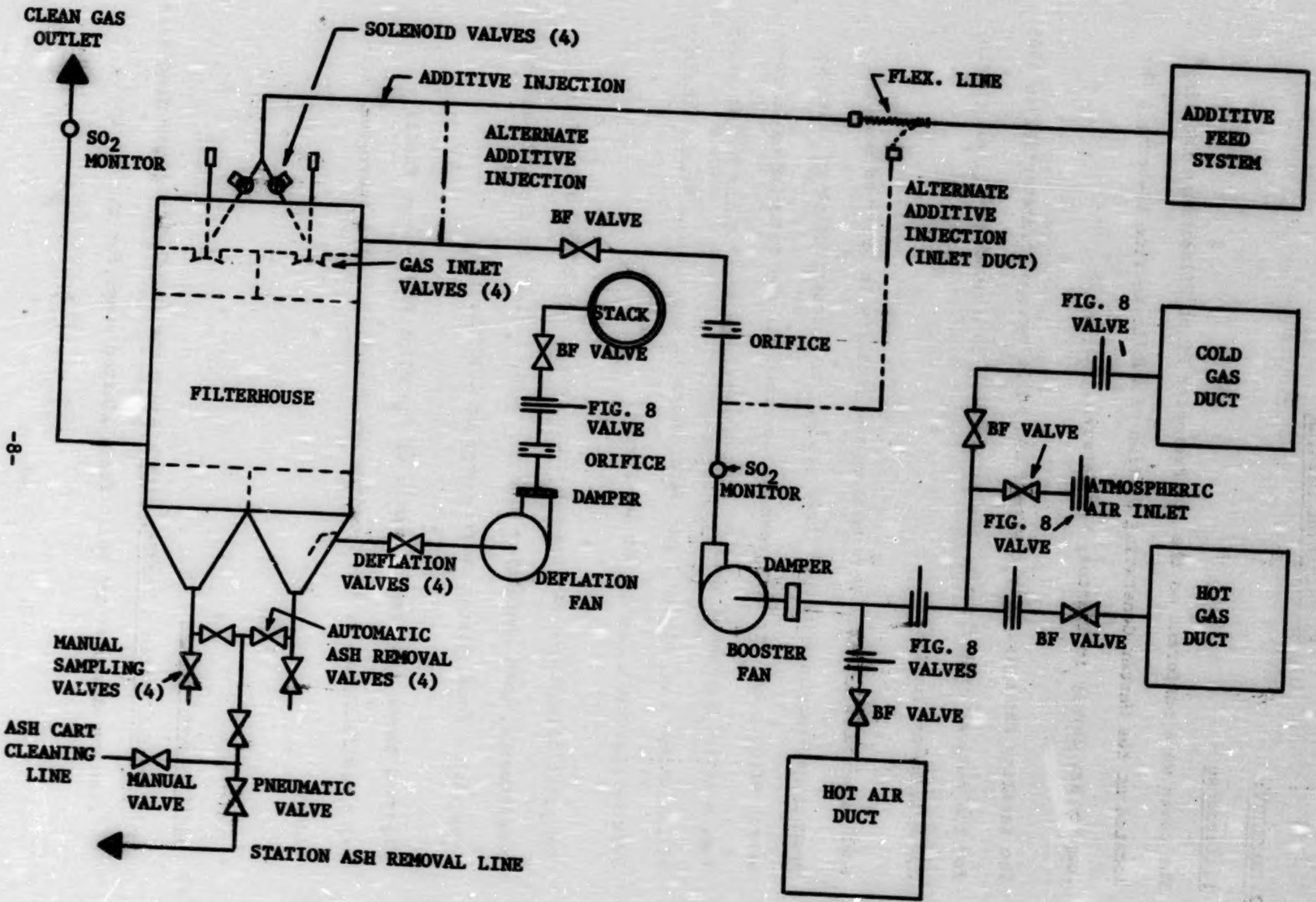

CLEAN GAS OUTLET
SOLENOID VALVES (4)
ADDITIVE INJECTION
FLEX. LINE
ADDITIVE FEED SYSTEM
SO_2 MONITOR
ALTERNATE ADDITIVE INJECTION
ALTERNATE ADDITIVE INJECTION (INLET DUCT)
BF VALVE
GAS INLET VALVES (4)
STACK
BF VALVE
ORIFICE
FIG. 8 VALVE
COLD GAS DUCT
FILTERHOUSE
FIG. 8 VALVE
ORIFICE
BF VALVE
SO_2 MONITOR
DAMPER
ATMOSPHERIC AIR INLET
FIG. 8 VALVE
DEFLATION VALVES (4)
DEFLATION FAN
DAMPER
HOT GAS DUCT
BOOSTER FAN
FIG. 8 VALVES
BF VALVE
MANUAL SAMPLING VALVES (4)
AUTOMATIC ASH REMOVAL VALVES (4)
BF VALVE
ASH CART CLEANING LINE
MANUAL VALVE
PNEUMATIC VALVE
HOT AIR DUCT
STATION ASH REMOVAL LINE

FIGURE 1. SYSTEM SCHEMATIC, PILOT FILTERHOUSE FACILITY

filterhouse project, it was considered not adequate and practical for this program where the feeding rate of varying quantities of various powdered additive materials was one of the most fundamental parameters of the test program. The original design was then studied and new components were designed, purchased and assembled to supplement the existing system.

The modified feeding system, as shown in Figure 2, consists of the following components:

a. Size 47-3206C-730 M/D (MGD Pneumatics, Inc.) three lobe positive displacement rotary blower, V-belt driven at 2340rpm by 5hp TEFC 1800rpm, 220/440V, 60 cycle, 3 phase motor. It has an operating capacity of 105cfm at up to 5psi. The ambient air intake of the blower is provided with an intake air filter.

b. Size FV-150 fluidizing rotary bulk material feed valve, roller chain driven by 1/2hp, 220/440V, 60 cycle, 3 phase, 9rpm TENV gear motor.

c. Model 120 Acrison volumetric metering feeder complete with reciprocating constant flow hopper, double auger feeder, sizes H and E for interchangeable control of flow rates. Feeder is operated by a variable speed, 1/2hp, 220/440V, 60 cycle, 3 phase, TEFC motor, with a capacity range 1-50 cu.ft. per hour.

d. Pressure relief vent with housing and 6" diameter x 6' long vertically suspended Nomex fabric filter tube.

e. Mechanical inclined belt conveyor manufactured by Air Preheater Co., Inc., is added to transport sacked additive materials from pallets at grade level to feed hopper. Conveyor utilizes a 12" wide x 7'9" long non-skid rubber belt operating at 30' per minute by 1/2hp, 220/440V, 60 cycle, 3 phase, gear motor.

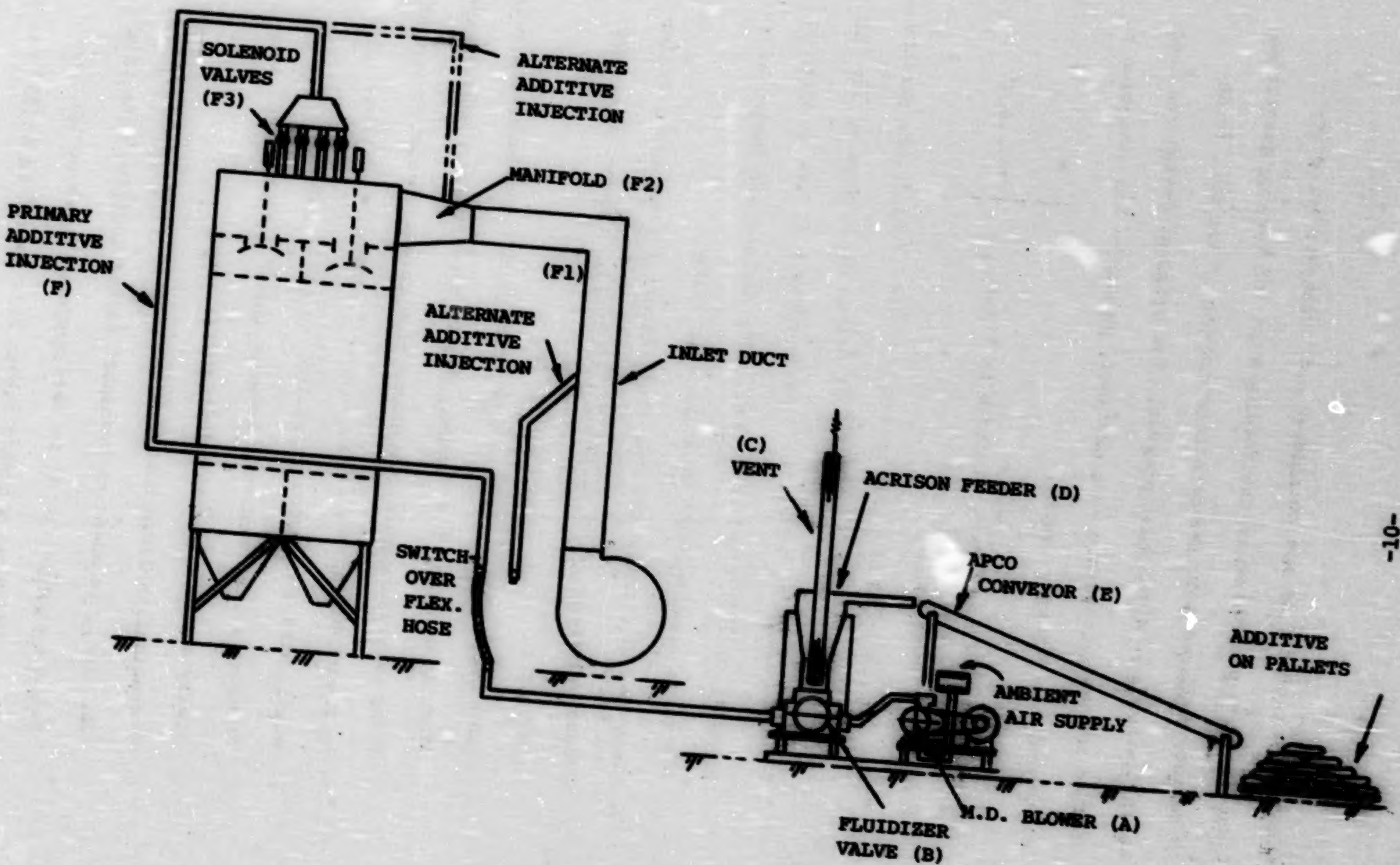

SOLENOID
VALVES
(F3)
ALTERNATE
ADDITIVE
INJECTION
MANIFOLD (F2)
PRIMARY
ADDITIVE
INJECTION
(F)
(F1)
ALTERNATE
ADDITIVE
INJECTION
INLET DUCT
(C)
VENT
ACRISON FEEDER (D)
SWITCH-
OVER
FLEX.
HOSE
APCO
CONVEYOR (E)
ADDITIVE
ON PALLETS
AMBIENT
AIR SUPPLY
FLUIDIZER
VALVE (B)
M.D. BLOWER (A)

FIG. 2. ADDITIVE FEED SYSTEM

f) Conveying transport duct system, consisting of 110' total length 2" pipe with five 90° and one 45° elbows to deliver bulk fluidized additive from grade level to each of three alternate receiving locations approximately 60' above grade. The alternate receiving points are:

   1) Gas inlet duct in the vertical section at a few feet above SO_2 analyzer probe.
   2) Manifold--in duct transition ahead of and above gas inlet valves.
   3) Solenoid operated 2" feed valves, manually/automatically controlled to feed additive through one to four open valves. Discharge side of each valve is connected to a 2" solid and flexible pipe with a configuration to discharge the additive to the center of each dished head compartment gas inlet valve.

2. Feeding Rate - A quantity of the various additives was shipped from the Mercer Station to the Engineering Laboratory at Wellsville for the purpose of calibrating the feeder prior to the shipment of the assembly to the site for installation. A series of calibration runs were conducted. Results were plotted as shown in Fig. 3.

When testing commenced at Mercer, it was found that the humidity and the degree of compaction greatly affected the apparent bulk density, hence, additional calibrations were performed in the field.

Additive: Sodium Bicarbonate

Apparent Bulk Density: 57.5 #/ft^3

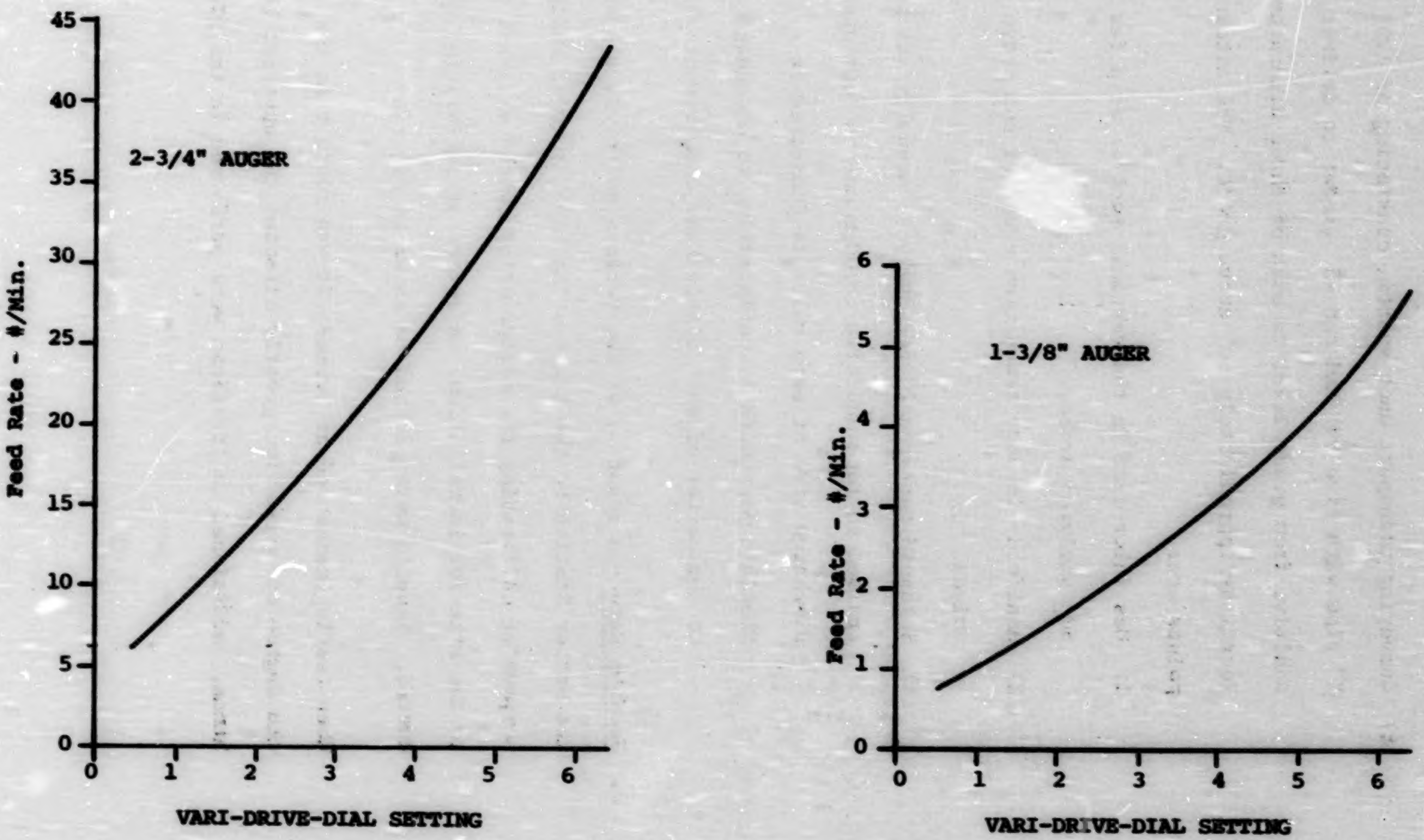


FIG. 3. ACRISON FEEDER CALIBRATIONS

For the test runs, the amount fed was timed at frequent intervals and minor adjustments of the feeder settings were made in order to maintain the desired feed rates. The overall additive material used for any test was recorded so that an error in feeder settings would not affect the overall data reduction of the tests.

As a result of the above, in addition to the fact that the inlet SO_2 level fluctuated considerably due to the variation of suflur content of the coal, the actual stoichiometric ratios of the additive to the sulfur content were not exactly the same as those predicted for the test, i.e., a test performed with a desired S.R. of 1.0 may result in an actual stoichiometric ratio of 0.89.

C) Deflation System -

Filter fabric cleaning on the four-compartment unit at Mercer Station depends on the reverse flow principle. A single-compartment is cleaned at a prescribed time of operation by reversing the flow of the gas from the clean side of the fabric through the media to the dirty side, thereby removing the accumulated dust cake deposit on the media surface. By exhausting this cleaning gas from the hopper zone at the bottom of the compartment, the filter tubes revert from an inflated on-stream condition to a deflated configuration--thus, the term given to this operation is "deflation".

1. Original Design - It was provided in the original design that the deflation gas from the hopper of the compartment being cleaned was recirculated into the chamber of the other three compartments and intermixed with the incoming flue gas. It was obviously not desirable for this test program. Therefore, the dusty deflation gas was directed and discharged to the boiler mainstack.

2. **Modifications** - Modifications were undertaken to divert the deflation gas flow from the existing 14" diameter vertical duct above the deflation fan to a horizontally supported 14" dia. duct approximately 200' in length, connecting into the stack base at 26' above grade. The duct contains a butterfly valve at the stack junction, a figure "8" blank-off valve midway in its length provisions for dust and gas sampling and expansion joint connections as required.

The existing 15hp deflation fan motor and support base were replaced by a 25hp TEFC motor (220/440V, 60 cycle, 3 phase, 1750rpm), base and V-belt drive. Directly above the fan discharge, the existing louvre flow control damper was retained, and converted from automatic to manual control.

D) **Outlet Stack** -

The outlet stack for the clean side gas was extended from an elevation of approximately 70' above grade to 150'. This was done at the request of Public Service New Jersey.

E) **Hoppers & Automatic Removal System** -

The hoppers were removed and replaced with ones of larger capacity in order to facilitate the high loading due to the addition of additives. Pneumatic rappers were installed on these hoppers to insure complete cleaning.

Since the existing system was not capable of handling the heavy dust loading required by this type of testing, an automatic ash removal system was added to the filterhouse. It was used to facilitate removal of the flyash and additive during periods of trial runs, precoating bags with various additives and overnight operation. It was also used to remove the discarded ash and additive samples from the ash carts and cans.

The system consists of both manual and automatic valves on the bottom of each of the four hoppers. The manual slide valves are used when removing a dust catch for sampling and weighing and the automatic valves were used as stated above.

In order to install the system, it was required to run an 8" line to the 7th floor of the power station where it was connected to the station's main eductor system. At this point of junction, a pneumatically operated United Conveyor valve which isolated the Air Preheater system from that of the generating station was installed. Permission from the station operating engineer was required to open this valve when needed.

F) Ducting System -

A hot-air duct was added between the air heater outlet duct and the inlet to the filterhouse. The hot air is provided to heat up the filterhouse to a temperature above the dewpoint of SO_3 on startups and shutdowns. This was also used to maintain the inlet gas temperature over 300°F for overnight operation as the process gas temperature decreased to 240°F at times.

A figure "8" valve was installed in the inlet duct adjacent to the booster fan so that manual work could be performed inside the filterhouse when the boiler was on stream, since the leakage through the existing butterfly valves was too great to allow this to be done in the past.

G) System Control -

The operation of the filterhouse is controlled from a central instrumentation trailer located at grade level. The basic functions accomplished by the controls are:

1. Cycling of compartments;
2. Timing of cycles;
3. Control and monitor gas flow rates;
4. Control and monitor gas temperature; and
5. Monitor various temperatures throughout the filterhouse (approx. 20 points).

Extensive modification was required in order to accomplish this test program. Some of these were:

1. Modify cycle timer to allow for variation of cycle duration.
2. Manual override of timer--required for parallel operation.
3. Automatic and manual control of the additive feed system solenoid valves.
4. Control for the main ash removal system valve (where the Air Preheater's system connects to that of the station's system).
5. Individual control of the four (4) pneumatic ash removal valves on the bottom of the hoppers (automatic and manual).
6. Installation of the compartment "flow and ΔP" recorders.
7. Installation of the SO_2 recorder.

Also, due to the longer period of time when the unit was not in use, considerable restoration work was required.

H) Safety Enclosure -

A safety enclosure was installed on the top level of the filterhouse for the general safety and weather protection of the personnel and equipment.

It consists of a framework of 2 x 2 angles over which is attached translucent panels of fiberglass. The enclosure is built up from the upper platform and extends to approximately five (5) feet above the filterhouse's top. The open grating on the catwalk was covered with diamond pattern safety plate.

I) Instrumentation -

1. Flow Monitoring System - Eight (8) pressure transmitter-recorder combination were installed to continuously monitor the individual compartment flows and pressure drops.

   The flow to each compartment is controlled by a dish plate valve. The flow to each compartment must pass through an orifice plate. The pressure drop across these orifices are transmitted to recorders in the control trailer.

   A set of four transmitters (one for each compartment), were installed to continually monitor the pressure drop across the filterbags. These were also continuously recorded in the control trailer.

2. The SO_2 Monitoring System & Wet Chemical Analysis - This system was purchased from the Intertech Corporation. Basically the system is enclosed in an instrument housing located at the 26' level close to the

filterhouse. The filterhouse inlet and outlet SO_2 concentration levels were continually monitored through automatic sampling probes.

The data is continually recorded on a two pen recorder located in the filterhouse control trailer. This system has an automatic calibration feature which was set to recalibrate automatically twice a day and can also be manually calibrated at any timed as required.

a. SO_2 Chemical Analysis - Wet chemical analysis was performed periodically to confirm the instrument reading of SO_2 levels. The results of these tests were:

Level of SO_2 (ppm)

	Wet Chemical		Auto. Instrument	
Date	Inlet	Outlet	Inlet	Outlet
29 April 1969	750	670	815	728
30 April 1969	891	335	1200	400
2 May 1969	1089	589	1089	600
5 May 1969	1013	668	1200	750
6 May 1969	1021	972	1350	1075
18 Sept. 1969	880	612	1020	620
25 Sept. 1969	1788	1512	1750	1550
26 Sept. 1969	1674	1550	1620	1600

Due to the rapid fluctuation of SO_2 levels, which at times varied over 200ppm in a minute, perfect time correlation was difficult.

The question of stability of the SO_2 concentration of the calibration standard gas for the SO_2 monitoring instrument was the reason for the chemical tests to be performed. However the standard SO_2 gas for the monitoring system were analyzed by Scott Research Laboratory, Philadelphia, Penn., on 6 February 1969; and again on 29 May 1969, before and following the first phase test period. The results were as follows:

Cylinder No.	6 Feb. '69 Analysis	29 May '69 Analysis
B-457	1730ppm SO_2	1740ppm SO2
B-458	1770ppm SO_2	1770ppm SO_2
B-456	1690ppm SO_2	1690ppm SO_2
B-459	1700ppm SO_2	1710ppm SO_2

Bottles #B-457 and #458 were used during the low and medium temperature tests and #B-456 and B-459 were used during the high temperature test period.

This confirms the stability of the calibration bottles throughout the test program. Since the instrument was automatically calibrated at least two times every 24 hours, the accuracy of instrument readings were considered to be adequate for the evaluation of SO2 reduction for the test program.

b. SO3 Chemical Analysis - An attempt to measure sulfur trioxide was made at the same time that SO_2 wet chemical analysis was done. Two procedures were used: (1) HEW, and (2) Combustion Engineering. It was felt that the concentrations of SO3 existing in the stack, based on SO_2 levels, were too low for either method. Both methods have lower sensitivity limits of approximately, 25ppm of SO_3. Some calculations of SO_3 concentrations, based on SO_2 levels, were attempted and all fell in this range of the uncertainty 25ppm. A less significant factor is that the sampling point was located about 25' from the stack exhaust where the environment is not ideal for SO_3 analysis.

3. **Dust Sampling and Analysis** -

a. **Grain Loading** - Grain loading tests were performed on the inlet and outlet ducts to the filterhouse using Aerotec type dust samplers. The frequency of the inlet sample was once per day. Shown below are the results of the tests performed during the Phase I test period and those performed during the first part of the Phase II tests.

Figures are in grains per standard cubic foot per minute.

Date	Inlet	Outlet
29 April 1969	1.0	0.31
30 April 1969	1.0	
1 May 1969	1.78	
2 May 1969	1.41	0.042
5 May 1969	2.14	
6 May 1969	1.42	
8 May 1969	1.61	
5 June 1969	2.56	
6 June 1969	2.60	
7 June 1969	1.43	0.035
10 June 1969	1.93	
11 June 1969	1.63	
12 June 1969	2.79	
	1.792 - Average	

Additional tests were performed during the high temperature test phase; the results are listed below:

Date	Inlet	Outlet
16 Sept. 1969	1.91	0.00
17 Sept. 1969	1.78	0.54
18 Sept. 1969	2.23	
24 Sept. 1969	0.59*	

*Appears to be poor test.

An average of 1.8 gr/ft^3 was used for the inlet grain loading for the data reduction of all tests.

Tests could not be run during the latter part of the high temperature tests as the inlet duct feed point was being used extensively. As this feed point is ahead of the dust sampling point, the dust testing could not be performed simultaneously with the operation of the filterhouse.

b. Moisture Content of Flue Gas - Moisture content of the flue gas was also measured. In the June test series, the percentage of H_2O was 4.99% on the inlet and 4.60% on the outlet. Measurements taken on 9 September 1969 resulted in 4.9% H_2O in the inlet gas and 4.3% H_2O in the outlet. The percent water present in the stack gases was measured by drawing a known volume of gas through an impinger placed in an ice bath. One hundred ml of water was initially placed in the impinger. The change in volume of water and the readings from a wet gas meter indicated the percent of water present.

J) Filter Material -

The filter material used in the filterhouse for these tests is supplied with the following specifications:

Material - Fiberglas;

Permeability - 75 CFM/Sq.Ft. Clean @0.50"WG;

Count - 54 x 30;

Weave - 3 x 1 twill;

Yarn - Warp - 150's 1/2;

Fill - Bulked 1/4;

Weight - 10 oz/Sq. yard;

Mullen Burst Strength - 595 psi;

Construction - 11-1/2" dia. x 39'5" @25# tension support rings internally sewn at each end.

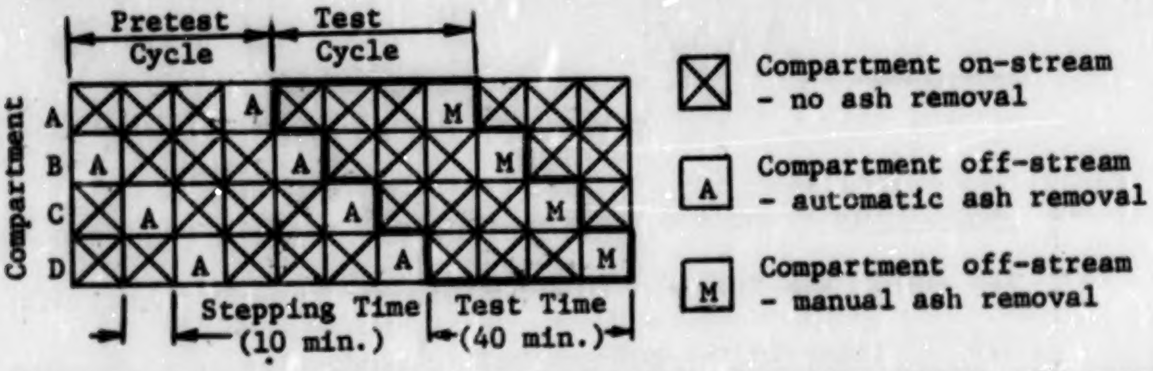
The material specification for both sets of bags used for the testing was identical. Since they were supplied by different suppliers, there were differences on the tolerance of the warp and fill. Also the tightness of the yarn was not quite the same.

II. TEST PROCEDURES:

A) Operation of Filterhouse -

For these tests, two (2) modes of house operation were used; cyclic and parallel.

1. **Cyclic Operation** - This mode of operation was nearly completely automatic from the filterhouse control trailer. The four compartments were "stepped" from one to the next at a specific time interval in such a way that each compartment was off-stream for one quarter of the complete cycle period. In other words, at any specific time three compartments were on-stream and one was off-stream. Three stepping times were used--10, 20, and 30 minutes resulting in 40, 80, and 120 minute cycle times. All cyclic test runs were performed such that each compartment had a complete pretest cyclic identical to the test cycle. In order to accomplish this, a total of three cycles for a test were required. Below is a diagram which illustrates the operational sequence.

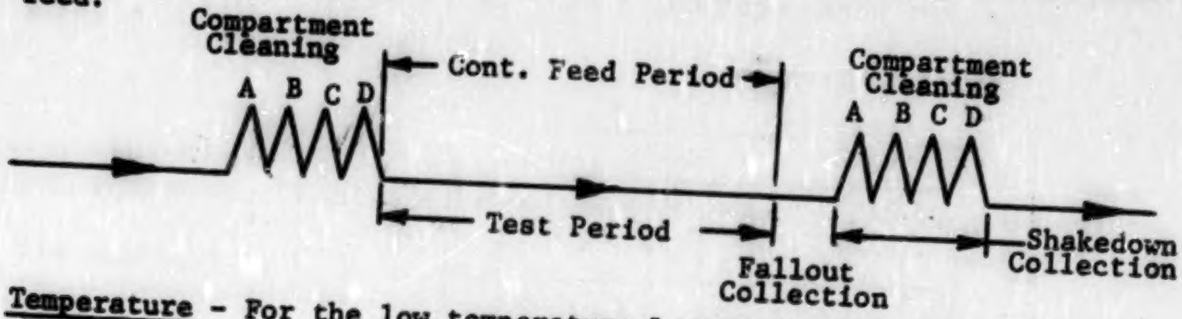

Pretest Cycle
Test Cycle
Compartment
A
B
C
D
A
M
Stepping Time (10 min.)
Test Time (40 min.)
☒ Compartment on-stream - no ash removal
A Compartment off-stream - automatic ash removal
M Compartment off-stream - manual ash removal

The 10-minute stepping period was selected as the minimum time required for the off-stream operation to perform the following tasks: (a) manual removal of the fallout (mixture of flyash and additive directly falling down into the hopper); (b) deflation of the filterbags to shake the filtercake down to the hopper; and (c) manual removal of the shakedown.

The additive solenoid valves were automatically controlled when filterhouse was in cyclic operation.

2. **Parallel Operation** - For this mode of operation all four (4) compartments were on stream for the complete test period and four solenoid valves were all open simultaneously.

Prior to starting a parallel test, all four compartments were cleaned manually in rapid sequence. This took a period of approximately 3 minutes. Upon completion of this cleaning, all four compartments are put on-stream and additive feed system started simultaneously. At the end of the test period, the fallout in all four compartments was collected first, then compartments were deflated and the shakedown was collected. The fallout collection and cleaning of all four compartments generally took a period of approximately six minutes. This was not included in the test time and no additive was being injected during this period. The diagram below illustrates this mode of operation with continuous feed:



3. **Temperature** - For the low temperature L series tests, the available gas supply was from the cold-gas side of the air heater with the figure "8" valve in the hot-gas duct closed. The test temperatures for this series ranged from 271°F to 292°F.

For the medium temperature M series tests, inlet gas temperatures were obtained by adjusting the two butterfly valves (cold and hot gas ducts) to arrive at a flow and temperature for the particular tests. The temperature range was selected as the higher operating temperature for sodium bicarbonate due to its low decomposition temperature. The actual tests temperatures for the "M" tests fell in the range of from 345° to 358°F.

There were two (2) special tests run using nahcolite where the temperature was lowered to the 300°F range by mixing with ambient air. These were to determine the effect of nahcolite at temperatures lower than 350°F (test #M-28 and #M-29). It would have been desirable to lower the temperatures to the 270°F range so as to make direct comparison of nahcolite with the sodium bicarbonate. The temperature reduction was limited by the SO_2 level of the flue gas at that time. Bleeding in of more ambient air would result in a ppm value below the minimum level of 800 required to evaluate the significance of the change in SO_2 conversion efficiency.

For the high temperature H series tests the cold-gas butterfly valve was closed and only the hot-gas was used as the source of flue gas. The temperature at hot gas value was normally at 680°F. The test inlet temperatures had never reached this value due to the following reasons: (a) there was some leakage from the 600° hot air duct butterfly valve; and (b) heat losses through the ductwork between the hot-gas valve and the inlet to the filterhouse. It was also found that higher flow rates resulted in higher inlet temperatures.

Chromel-alumel thermocouples were used to monitor the thermal behavior of the filterhouse. There were five (5) temperatures listed in the data sheets and they are:

(1) Inlet temperature--located between the booster fan discharge and the inlet orifice--approximately fifty-five (55') feet upstream from the inlet to the filterhouse.

(2) Manifold temperature--located at the top of the filterhouse where the gas enters.

(3) Upper fabric--located just below the upper tube sheet.

(4) Lower fabric--located just above the lower tube sheet.

(5) Outlet stack--located in the gas outlet stack where the stack attaches to the filterhouse.

The rest of the thermocouples were distributed to various locations, such as, upper compartment chambers, lower compartment chambers, hoppers, fan bearings and deflation discharge. All temperatures were monitored and recorded on a Honeywell 24 point recorder.

B) Additive Feeding -

The system design for feeding the additive along with the three (3) feedpoints used is described in an earlier section of this report. Two (2) different feeding methods were used--continuous and batch.

1. Stoichiometric Ratio - The following equation was used to determine the additive feed rates to be used for the various tests:

$$W = (SR)(Q)(c)(a)(M)/(R)(T)$$

Where,

W = Mass rate of additive, lbs/min.

$SR = \text{Stoichiometric ratio} = \dfrac{\text{(Additive required for Test)}}{\text{(Additive req'd. for Stoich. reaction)}}$

Q = Actual flow rate of flue gas, ACFM

c = Inlet gas SO_2 concentration, ppm

a = Stoichiometric coefficient for the additive material in stoichiometric chemical reaction with one mol of SO_2, mol additive/mol SO_2.

M = Molecular weight of additive

R = Gas constant = 0.73

T = Absolute temperature of flue gas, °R.

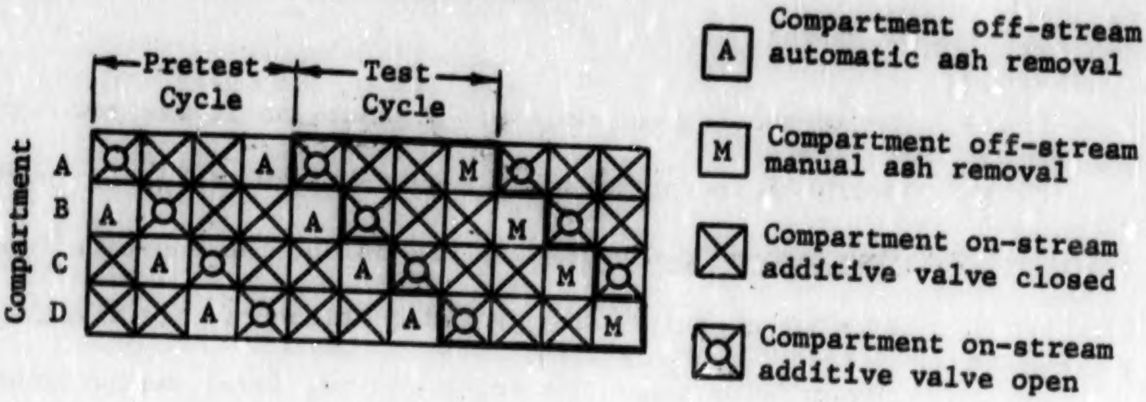
Values of stoichiometric ratios used for all tests were generally selected around one (unity), two and three. Due to high fluctuations of gas inlet SO_2 levels and the inaccuracy of feeder calibration resulting from the uncertainty of the bulk density of the additives, the actual test stoichiometric ratios differed somewhat from those predicted.

No correction was made for pressure as it was low. Normally the house operated in the pressure range of 5-10 inches of water column.

2. Continuous Feed - In this operation, the additive feed system was set at desired rate and operated continuously for the total test period. During some tests the inlet gas SO_2 level varied considerably and the additive feed rates were periodically adjusted so that the desired stoichiometric ratio could be approximately maintained. For cyclic operation of the filterhouse the additive solenoid valves were synchronized with the compartment inlet valves. The additive valves could then close with the corresponding inlet gas valves on the compartments.
3. Batch Feed - Two systems were used for batch feeding, depending on the mode of house operation.
    a. Parallel Operation - The total predicted test additive was completely injected at one time at the beginning of the test. The maximum feed rate of the system was approximately 45 #/min. A number of tests were supplied with additive at this rate. Most of the

batch tests were conducted with lower feed rates to reduce the excessive additive fallout.

b. Cyclic Operation - The automatic control of the additive solenoid valves was set up as follows: Following the cleaning of a compartment, this compartment was placed back on stream and its additive solenoid valve opened with the other three valves remaining closed. This valve remained open for the first ten minutes of its 30 minute on-stream period. This sequence was typical for all four compartments.


Pretest Cycle
Test Cycle
Compartment
A
B
C
D
M
A
Compartment off-stream automatic ash removal
Compartment off-stream manual ash removal
Compartment on-stream additive valve closed
Compartment on-stream additive valve open

4. Flow - The required gas flow rate was obtained by the use of both manually and automatically controlled valves. The basic range of flow rate was established by manual setting of the butterfly valves in the hot and cold gas ducts. The fine control was accomplished by the use of pneumatically operated louver dampers at the booster fan inlet. The flow rate measuring orifice was located approximately 35' upstream from the inlet to the filterhouse. The pressure drop across the orifice was continually recorded on a strip chart recorder located in the control trailer.

5. Additive Feeding Point - There were three (3) different feed points being used for all the tests;

a. Solenoid Valves - The main additive feed line enters a distribution box on the top of the filterhouse. There it separates into four (4) individual lines, each of which feed one compartment as shown in Fig. 11 . These four lines are individually controlled with solenoid valves so that every compartment could be fed independently as desired, as described previously depending on the mode of house operation being used.

b. Inlet Manifold - During pretest preparations there was difficulty in obtaining uniform flow distribution through the four solenoid valves. It was decided to enter the main feed line at the inlet to the manifold on the top of the filterhouse. This line was directed at the point of highest flow in the inlet duct. Inside the 2" pipe, a small line was run in the center supplying high pressure (80 psig) air, which was used as an aid to disperse the additive in the duct. Tests were performed using this feed point. The additive distribution was not significantly improved by the use of this feed point.

Since its use added little to overall retention time of the additive and also did not lend itself to the batch feed method when the house operation was in the cyclic mode, the use of this feed point was discontinued.

c. Inlet Duct - The 2" main feed line was run into the 30" inlet duct approximately 46' upstream of the filterhouse manifold. This line was inserted at approximately a 45° angle and the end was cut in the horizontal plane. When fed at this location, the additive has a longer retention time in the gas stream than in (a) and (b).

NOTE: Feed points (a) and (b) were considered the same for the evaluation of the tests.

C) Ash and Additive Collection -

1. Fallout - The fallout (the mixture of flyash and additive which fell directly into the hoppers) was collected in the "ash carts" prior to deflation. This was accomplished by manually opening the slide gate valves on the bottom of the hoppers.
2. Deflation - It was found that quite significant amount of the ash and additive mixture was carried out through the deflation system directly to the main station stack. Attempts to measure this amount, using Aerotec samplers were unsuccessful. A sample of the deflation dust for each test was collected for chemical analysis only.
3. Shakedown - This shakedown mixture was taken immediately following the deflation of the bags. It was also collected in either "ash carts" or "ash cans" depending on the quantity.

All the collected flyash and additive mixture above were then weighed and recorded. Following this, one (1) quart samples of the fallout and shakedonw were taken from each individual compartment collection. These were composed of many small amounts gathered from various parts of the collection container.

These quart samples, together with the deflation samples, were then analyzed by NAPCA in Cincinnati. The resulting data was then used for the SO_2 conversion distribution analysis. The data is also shown on the individual data sheets included in the appendix. Since some of the sample jars were broken and the identifications on some others were accidentally washed off during transportation, the data was not complete.

III. DISCUSSIONS OF RESULTS:

There were 62 tests performed on the filterhouse facility to investigate the feasibility in using the fabric filter bag as a chemical contactor for the removal of SO_2 from boiler flue gases. Five different sorbent materials were tested as reacting additives under various operating conditions. It may be summarized as follows:

Additive	Number of Tests at 270°-300°F	350°F	500°-630°F	Total
Sodium Bicarbonate	13	15	4	32
Nahcolite	2	11	2	15
Hydrated Dolomite		2	6	8
Promoted Hydrated Dolomite		2	1	3
Chemical Hydrated Lime		2	2	4
Total Number of Tests -	15	32	15	62

Because of the imperfect contact of the SO_2 vapor with the solid sorbent particles, it was expected that the chemical reaction of this two-phase system would not take place stoichiometrically. Therefore, effects of various operating parameters were all observed and studied for each individual additive. Throughout this study the terms, "SO_2 Conversion Efficiency" and "Additive Utilization Effectiveness" are used exclusively as the bases for comparison. They are defined as follows:

SO_2 Conversion Efficiency - This term is self-explanatory. Letting

η = SO_2 conversion efficiency,

C_i = Inlet SO_2 concentration level, ppm, and

C_o = Outlet SO_2 concentration level, ppm,

the SO_2 conversion efficiency is defined as,

$$\eta = \frac{C_i - C_o}{C_i}$$

The average inlet and outlet SO_2 levels for the tests were determined by the use of a Merium planimeter in conjunction with the SO_2 strip charts.

Additive Utilization Effectiveness - In spite of the imperfect chemical reaction of the vapor-solid system, the SO_2 conversion efficiency could be partially improved by feeding additives at a quantity of a stoichiometric ratio of more than unity at the expense of the effectiveness in utilizing additives. The additive utilization effectiveness is, therefore, to be considered as an economical factor in evaluating the SO_2 control process. The mass rate of the additive fed into the system for each test is calculated for 100% conversion of the inlet SO_2 at certain desirable stoichiometric ratio. The mass rate of the additive actually reacted with SO_2 may also be calculated from the net change of SO_2 concentration level by measurements. Hence, the ratio of these two quantities is the definition of the additive utilization effectiveness, or

$$U_t = \frac{\text{Mass of Additive Actually Reacted With } SO_2}{\text{Mass of Additive Actually Fed}}$$

For a set of constant operating parameters and inlet SO_2 concentration level, the theoretical utilization effectiveness can be expressed as follows:

$$U_t = \frac{(C_i - C_o)}{(C_i)(SR)}$$

Or,

$$U_t = \frac{\eta}{SR};$$

where SR = Stoichiometric ratio. In general, the actual SO_2 concentration level fluctuated at all times. The additive feed rate was manually controlled and was kept constant unless SO_2 concentration level changed considerably. Therefore, the actual additive utilization effectiveness was somewhat different from the theoretical one.

Operating parameters that were considered as controlling variables are the following:

a) Stoichiometric Ratio - SR = 1, 2, & 3.

b) Operating Temperature - T = 270°F, 350°F, & 600°F.

c) Flow Rate - Q = 7500 acfm, 10000 acfm & 15000 acfm.

d) Cycle Time - t = 40 min., 80 min., & 120 min.

e) Additive Feeding Method - Continuous feed and batch feed.

f) Retention Time - feeding points and flow rates.

g) Filter Ratio - Flow rates, cyclic and parallel operation.

The SO_2 conversion efficiency, η, and additive utilization effectiveness, U_t, are, thus, considered as the controlled variables. Test results were analyzed and compared accordingly.

Effort was also made to study; (a) the SO_2 conversion distribution in the filterhouse, and (b) the specific resistance of the filtercake:

SO_2 Conversion Distribution in the Filterhouse - While the additive is traveling through the filterhouse, the chemical reaction between the SO_2 vapor and the solid particles will take place (a) in suspension in the gas stream, and (b) at the filtercake on the bag fabric as the flue gas passes through. In order to analyze SO_2 conversion distribution the following assumptions were made:

a) The two-phase system with its chemical reaction was uniform throughout.

b) No chemical reaction took place in the hopper.

c) The sulfur content in the fallout sample was the same as that in the shakedown and deflation samples prior to deposit on the bag fabric. In other words, the total sulfur contents found in the shakedown and deflation samples was considered to include both the SO_2 conversion in suspension and that on the bags.

Sample calculations for this analysis are shown in Appendix B.

Specific Resistance of the Filtercake - According to Robinson et al (1) the specific resistance of the filtercake, K, is a measure of the resistance of the filtercake build-up to the gas flow. Letting;

Q = Total gas flow rate, acfm;

A = Total filter area on stream, sq. ft.;

Δp = Pressure drop across filter medium with or without filtercake, in. H_2O;

$F_R = Q/A$ = Filter ratio (of filter face velocity), fpm;

$S = \Delta p/F_R$ = Filter drag, (in.H_2O)/fpm;

S_T = Total drag of filter with filtercake, (in.H_2O)/fpm;

S_R = Residual drag of filter after cleaning, (in.H_2O)/fpm;

W = Mass of filtercake per unit filter area, lb/ft^2.

The specific resistance for these tests may be defined as,

$$K = \frac{S_T - S_R{}^*}{W} = \frac{A}{QW}\left[\Delta p_{dirty} - \Delta p_{clean}\right], \quad (\text{in.}H_2O/\text{fpm})/(\text{lb}/\text{ft}^2)$$

The drags, S_T and S_R, were calculated from the correspondent average Δp's. The mass of filtercake, W, was the difference of the measured masses of the input and fallout of the combined additive and flyash.

The 62 tests are grouped into three separate sections catagorized by the additives, namely, sodium bicarbonate, nahcolite, and limes. Results of each additives were analyzed and discussed in the following respective sections.

*S_R would need to be replaced with S_E, effective drag, for more sophisticated data.

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(1) Robinson, J. W., Harrington, R. E., Spaite, P. W. "A New Method for Analysis of Multi-compartmented Fabric Filtration". National Center for Air Pollution Control, Ohio. Presented at the 58th National Meeting, AIChE (February 1966).

A) Sodium Bicarbonate, $NaHCO_3$ -

The sodium bicarbonate used for tests was in a powder form and supplied with the following specifications:

Purity - 99.84% (considered as 100% for all calculations)

Sieve Data:

Mesh Size	45	100.0	200.0	400.0
% Passing	100	99.5	65.0	20.0

The stoichiometric reaction between the SO_2 vapor and $NaHCO_3$ powder may be described as

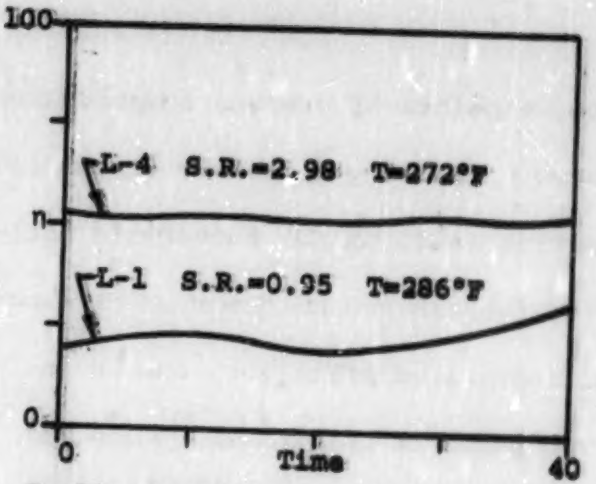
$$2NaHCO_3 + SO_2 + 1/2\ O_2 \rightarrow Na_2SO_4 + H_2O + 2CO_2 \ .$$

There were 32 tests performed on the filterhouse using this powdered sodium bicarbonate as the additive for SO_2 conversion under various operating conditions. Measurements and results of these tests are summarized as shown in Table 1. Although at 518°F sodium bicarbonate will decompose, tests with gas inlet temperatures to 606°F were conducted. Excellent results were obtained as shown in Table 1. Effects of various operating parameters on SO_2 conversion efficiency were studied and presented as follows:

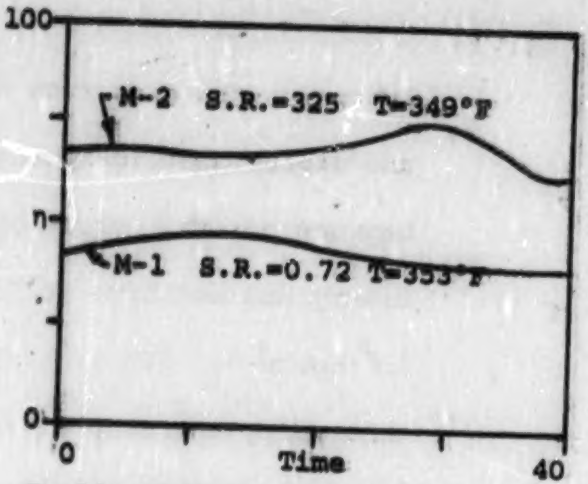
1. Effect of Stoichiometric Ratio - Typical SO_2 conversion efficiency histories of sodium bicarbonate at different temperatures, stoichiometric ratios and operating conditions are plotted as shown in Fig. 4. The peak conversion efficiency of M-7, parallel operation--batch feed at 350°F, compared with M-5 of parallel operation--continuous feed at 351°F was interesting. Refer to the section on "Comparisons of Continuous and Batch Feeding" for discussions on this effect.

TABLE 1. SUMMARY OF SODIUM BICARBONATE TESTS

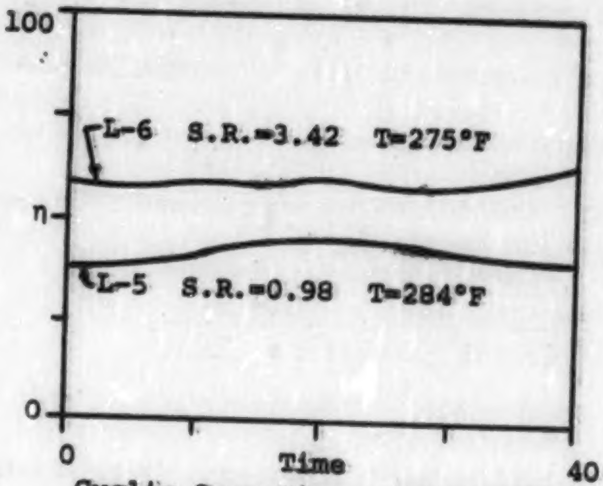
Test No.	Baghouse Operation	Feed Method	Cycle Time Min.	Retention Time Sec.	Gas Temp. In °F	Gas Temp. Out °F	Stoic Ratio	Total Flow Rate ACFM	House Avg. ΔP "H_2O	Add. Feed Rate #/Min.	SO_2 In ppm	SO_2 Out ppm	SO_2 Conv. Eff.%	Add. Util. %	Spec. Resist. Filter Cake	Conv. on Bags %
L-1	Cyclic	Cont.	40	3.520	286	242	0.952	10125	4.99	2.96	995.5	748.5	24.8	25.7	----	----
L-2	Cyclic	Cont.	80	3.494	292	256	0.739	10200	5.24	3.15	1366.4	832.7	39.1	52.3	----	----
L-4	Cyclic	Cont.	40	2.865	272	248	2.978	9800	4.99	10.49	1143.2	548.6	52.0	18.2	----	88.87
L-5	Cyclic	Batch	40	2.808	284	250	0.976	10000	5.09	31.82	1052.7	627.3	40.4	42.0	----	----
L-6	Cyclic	Batch	40	2.836	275	248	3.425	9900	4.94	43.60	1026.7	397.4	61.3	17.9	----	----
L-7	Parallel	Cont.	114	4.455	282	249	1.220	10100	4.75	3.11	818.8	576.2	29.6	22.8	13.40	----
L-8	Parallel	Cont.	145	4.500	283	250	1.131	10000	5.70	3.67	1047.4	602.0	42.5	37.0	15.70	----
L-9	Parallel	Cont.	161	4.545	284	250	3.179	9900	6.10	8.51	873.6	597.4	31.6	9.8	8.05	----
L-9A	Parallel	Ccnt.	161	5.855	292	253	2.500	10000	6.00	6.15*	881.6	600.1	31.9	13.3	11.80	----
L-10	Parallel	Cont.	180	3.820	271	248	3.657	9800	5.50	11.25	997.0	322.0	67.7	18.1	7.87	----
L-11	Parallel	Batch	120	4.500	280	248	0.979	10000	5.85	43.72	1286.8	837.0	35.0	35.7	----	----
L-12	Parallel	Batch	60	4.390	283	250	2.794	10250	4.80	42.46	1296.3	471.2	63.7	22.8	----	86.69
L-14	Parallel	Cont.	55	2.513	312	275	1.137	14900	7.49	6.36	1259.3	767.6	39.1	33.9	18.00	----
L-3	Cyclic	Cont.	120	2.773	350	300	0.987	10125	6.57	3.79	1335.2	624.0	53.3	54.1	----	72.73
L-13	Parallel	Cont.	120	3.791	351	296	0.893	9875	4.02	2.83	1132.2	497.9	56.0	62.3	10.00	----
M-1	Cyclic	Cont.	40	2.740	353	290	0.770	10250	5.08	3.65	1634.2	952.4	41.7	53.8	----	----
M-2	Cyclic	Cont.	40	2.740	349	283	3.250	10250	4.44	11.00	1161.5	349.0	69.9	21.3	----	----
M-3	Cyclic	Batch	40	2.726	349	290	0.936	10300	5.54	9.91	996.2	514.4	47.9	51.8	----	75.07
M-4	Cyclic	Batch	40	2.740	354	295	3.097	10250	4.98	44.0	1103.5	231.8	79.0	25.5	----	86.15
M-5	Parallel	Cont.	122	3.744	354	300	1.010	10000	5.03	4.63	1624.4	821.6	49.4	48.9	11.30	----
M-6	Parallel	Cont.	135	3.653	350	290	2.790	10250	6.08	12.37	1523.6	342.6	77.5	27.5	8.67	89.23
M-7	Parallel	Batch	120	3.653	350	290	1.103	10250	4.78	25.0	907.8	555.5	38.9	35.2	----	94.91
M-8	Parallel	Batch	60	3.617	349	286	2.917	10350	4.34	38.52	1009.1	396.4	60.7	20.8	----	----
M-25	Parallel	Cont.	60	4.860	349	276	0.885	8000	1.55	1.59	788.3	324.4	59.1	64.1	5.00	----
M-26	Parallel	Cont.	75	3.744	356	298	0.886	10000	4.00	2.94	1158.6	554.9	52.1	59.4	16.90	----
M-27	Parallel	Cont.	28.5	2.490	355	318	0.809	15000	7.50	4.74	1378.5	853.8	38.1	48.2	25.8	----
M-31	Parallel	Cont.	60	3.744	352	294	2.800	10000	3.30	7.85	978.8	164.6	83.2	29.5	7.40	----
M-32	Parallel	Cont.	60	5.712	350	295	2.440	10250	3.50	7.40*	1045.5	150.5	85.6	35.9	5.50	----
H-8	Parallel	Cont.	60	5.787	542	412	1.860	8500	1.50	5.42	1489.0	39.0	97.5	52.2	0.91	45.29
H-9	Parallel	Cont.	60	3.228	532	395	1.970	8700	1.60	6.08	1525.0	24.0	98.4	49.8	0.74	37.64
H-10	Parallel	Cont.	60	5.927	496	358	1.350	8300	1.25	3.48	1289.0	70.0	94.6	70.0	0.78	37.87
H-13	Parallel	Cont.	45	3.999	606	477	0.970	12300	2.96	4.74	1841.0	276.0	85.0	87.6	4.21	28.27



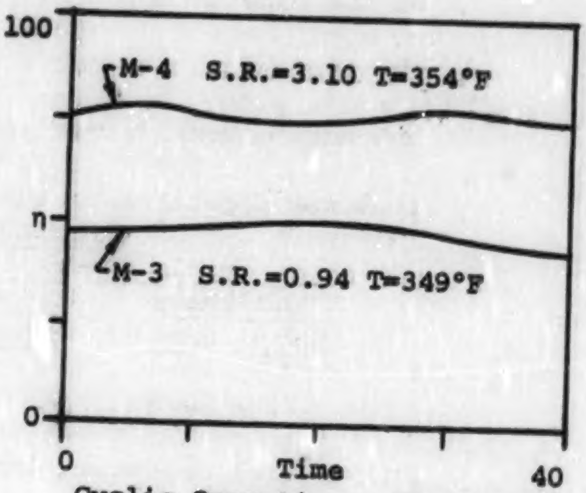
Cyclic Operation - Continuous Feed



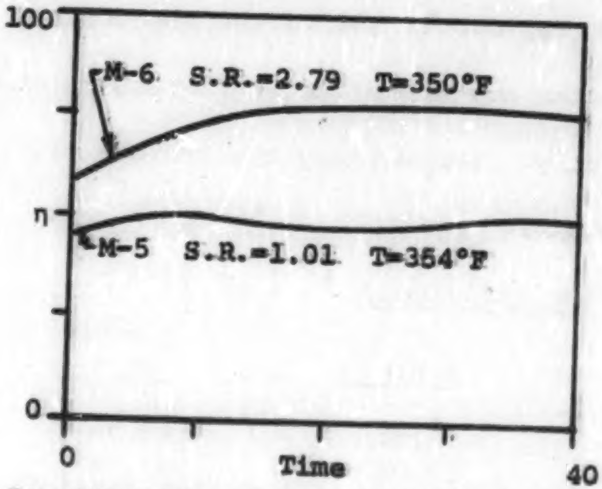
Cyclic Operation - Continuous Feed



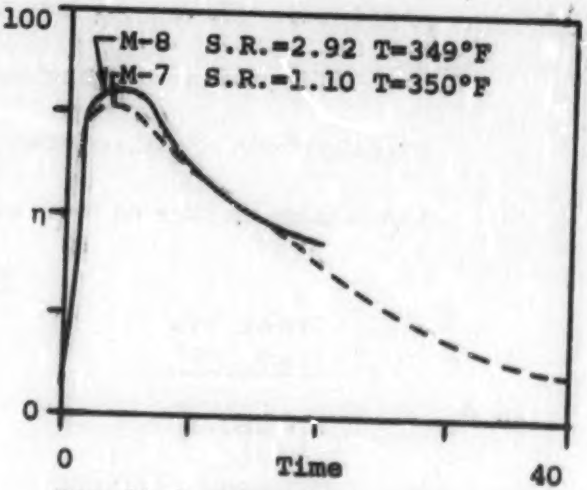
Cyclic Operation - Batch Feed



Cyclic Operation - Batch Feed



Parallel Operation - Continuous Feed



Parallel Operation - Batch Feed

FIG. 4. TYPICAL SO_2 CONVERSION EFFICIENCY HISTORY - STOICHIOMETRIC RATIO COMPARISON
$NaHCO_3$

Averaging the data from the 32 tests, 6 points of average temperatures and stoichiometric ratios are obtained. Assuming linear relationships between points, effect of stoichiometric ratio on SO_2 conversion efficiency and additive utilization effectiveness can be observed as shown in Figure 5. It is clear that SO_2 conversion efficiency can be increased by increase of stoichiometric ratio at an expense of losing additive utilization effectiveness.

It is also interesting to note that the amount of additive deposited on the bags is not directly proportional to the total amount added as the stoichiometric ratio changes. Averaging the data from the 28 low and medium temperature tests to determine the average % of additive that was deposited on the filterbags, the following comparison results:

Average % Additive on Bags

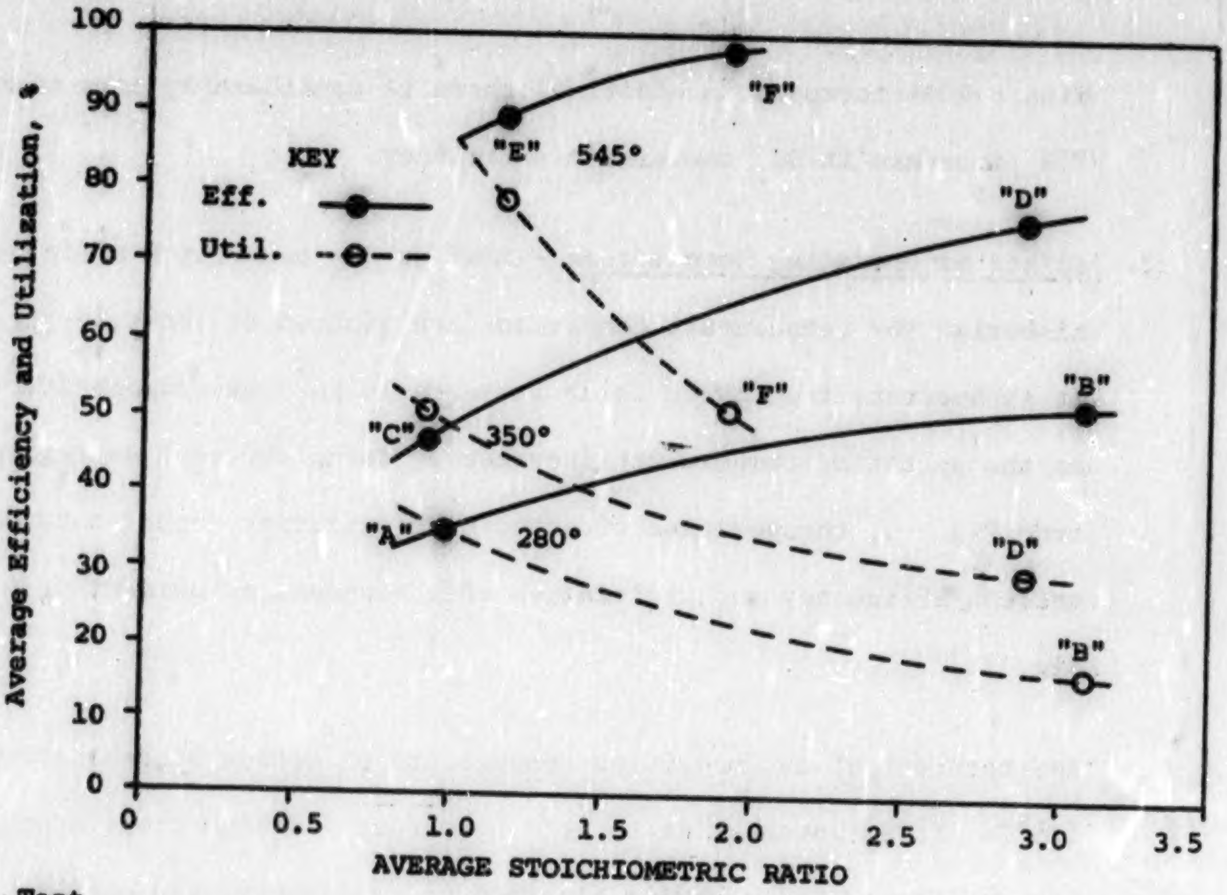
Cyclic Operation				Parallel Operation			
Continuous		Batch		Continuous		Batch	
SR=1	SR=3	SR=1	SR=3	SR=1	SR=3	SR=1	SR=3
67.0	50.5	70.0	31.0	56.8	54.2	64.5	57.0

In parallel operation (continuous or batch feed), the amount deposited on the bags varies only a few percent when the stoichiometric ratio is changed. The four (4) high temperature runs were all cyclic operation, continuous feed. As the temperature approaches 600°F, the SO_2 conversion efficiency approaches 90% negating any advantage in increasing the stoichiometric ratio greater than unity. Summarizing the average of the tests on the effect of stoichiometric ratio.

SO_2 Conversion Efficiency

Inlet Gas Temp. °F	S.R.=1	S.R.=3	% Gain in η
280	35.2%	51.5%	68.3%
350	50.5%	77.0%	65.6%
550	87.0%	98.5%*	13.2%

*S.Ratio = 2



Test No.	Temp.	S.R.	η	% Util.
		POINT "A"		
L-1	286	0.952	24.8	25.7
L-2	292	0.739	39.1	52.3
L-5	284	0.976	40.4	42.0
L-7	282	1.220	29.6	22.8
L-8	283	1.131	42.5	37.0
L-11	280	0.979	35.0	35.7
Avg.	284	0.9995	35.2	35.9
		POINT "B"		
L-4	272	2.978	52.0	18.2
L-6	275	3.425	61.3	17.9
L-9	284	3.179	31.6	9.8
L-9A	292	2.500	31.9	13.3
L-10	271	3.657	67.7	18.1
L-12	283	2.794	63.7	22.8
Avg.	279	3.088	51.4	16.7
		POINT "D"		
M-2	349	3.250	69.9	21.3
M-4	354	3.097	79.0	25.5
M-6	350	2.790	77.5	27.5
M-8	349	2.917	60.7	20.8
M-31	352	2.800	83.2	29.5
M-32	350	2.440	85.6	35.9
Avg.	351	2.880	76.0	26.8

Test No.	Temp.	S.R.	η	% Util.
		POINT "C"		
L-3	350	0.987	53.3	54.1
L-13	351	0.893	56.0	62.3
M-1	353	0.770	41.7	53.8
M-3	349	0.936	47.9	51.8
M-5	354	1.010	49.4	48.9
M-7	350	1.103	38.9	35.2
M-25	349	0.885	59.1	64.1
M-26	356	0.886	52.1	59.4
M-27	355	0.809	38.1	48.2
L-14	350	1.137	39.1	33.9
Avg.	352	0.942	47.6	51.2
		POINT "E"		
H-10	496	1.350	94.6	70.0
H-13	606	0.970	85.0	87.6
Avg.	551	1.160	89.8	78.8
		POINT "E"		
H-8	542	1.860	97.5	52.2
H-9	532	1.970	98.4	49.8
Avg.	537	1.915	97.95	51.0

FIG. 5. EFFECT OF STOICHIOMETRIC RATIO, $NaHCO_3$

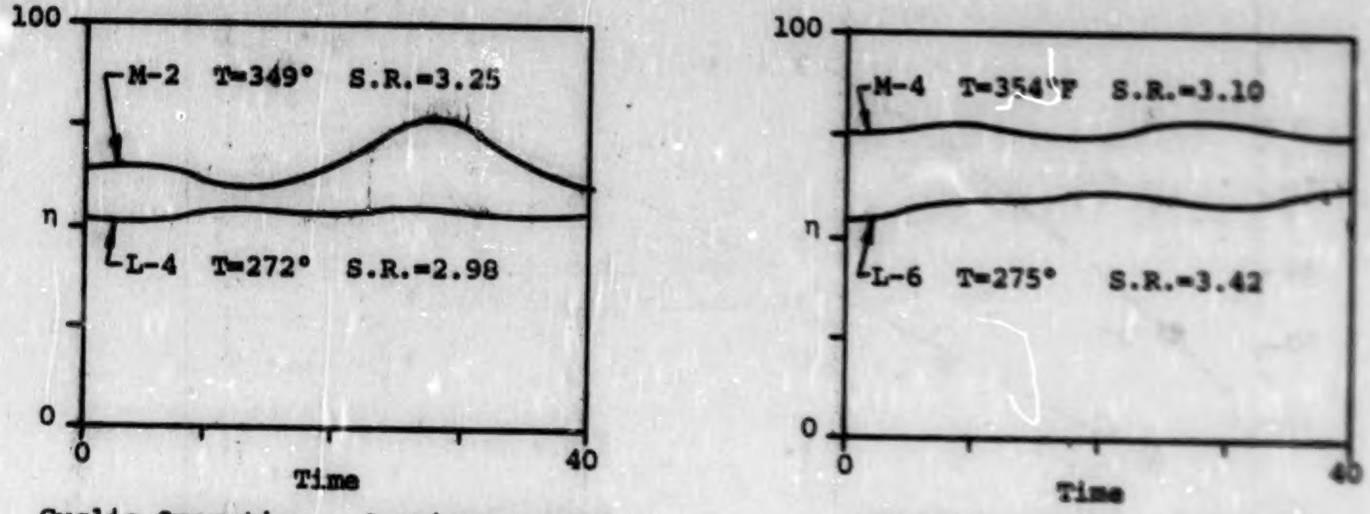
With a 200% increase in additive, there is considerably less than a 70% increase in SO_2 conversion efficiency.

2. Effect of Operating Temperature - Similar SO_2 conversion efficiency histories for temperature comparison are plotted as shown in Fig. 6. It is apparent that there is an increase in SO_2 conversion efficiency as the operating temperature increases. Using the same average points from Fig. 5, the positive effect of the operating temperature on conversion efficiency and utilization effectiveness is evident from Fig. 7.

The theoretical decomposition temperature of sodium bicarbonate is at 518°F. It is interesting to note that four (4) high temperature tests were performed using sodium bicarbonate as additive and excellent results were observed. Temperature data of these tests are listed as follows:

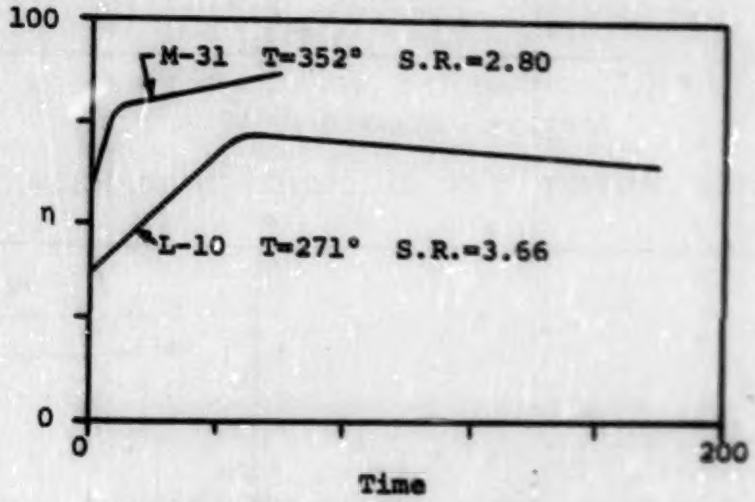
Test No.:	H-8	H-9	H-10	H-13
Inlet Duct	542	532	496	606
Manifold	490	510	432	558
Upper Fabric	480	490	430	547
Lower Fabric	435	433	396	513
Outlet Duct	412	395	358	477
SO_2 Conv. Eff., %	97.5	98.4	94.6	85.0
Stoich. Ratio	1.86	1.97	1.35	0.97
Utilization, %	52.2	49.8	70.0	87.6
Feeding Point	Inlet Duct	Inlet Values	Inlet Duct	Inlet Duct

Because of the hydroscopic nature of sodium bicarbonate, the fine particles tend to agglomerate. It was felt that at high temperatures

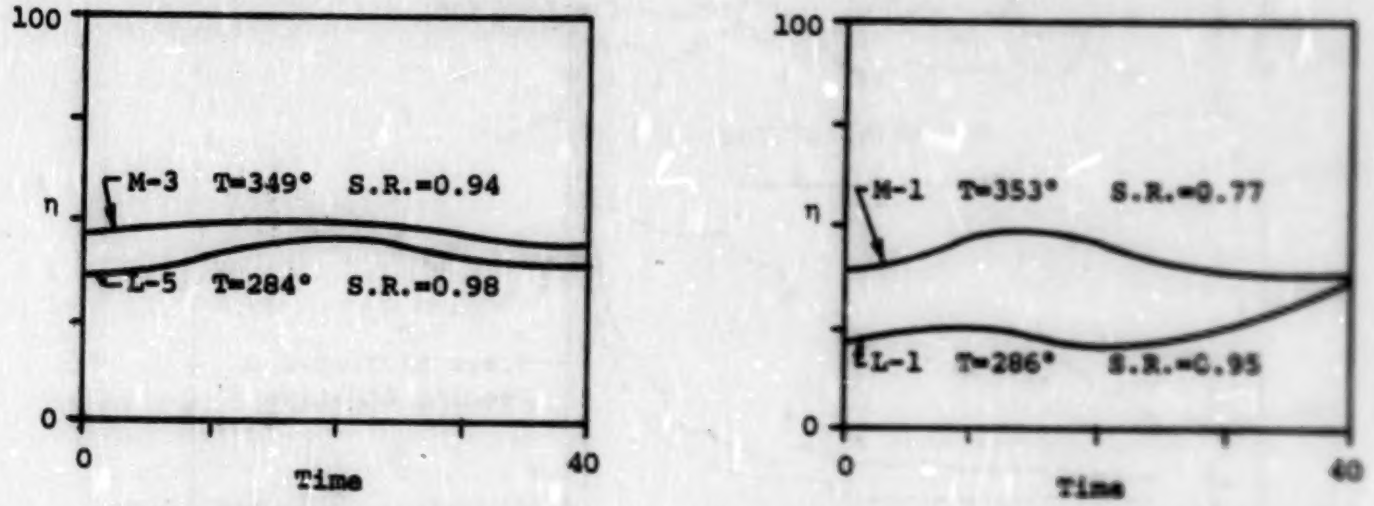


Cyclic Operation - Continuous Feed

Cyclic Operation - Batch Feed



Parallel Operation - Continuous Feed



Cyclic Operation - Batch Feed

Cyclic Operation - Continuous Feed

FIG. 6. TYPICAL SO_2 CONVERSION EFFICIENCY HISTORY - TEMPERATURE COMPARISON

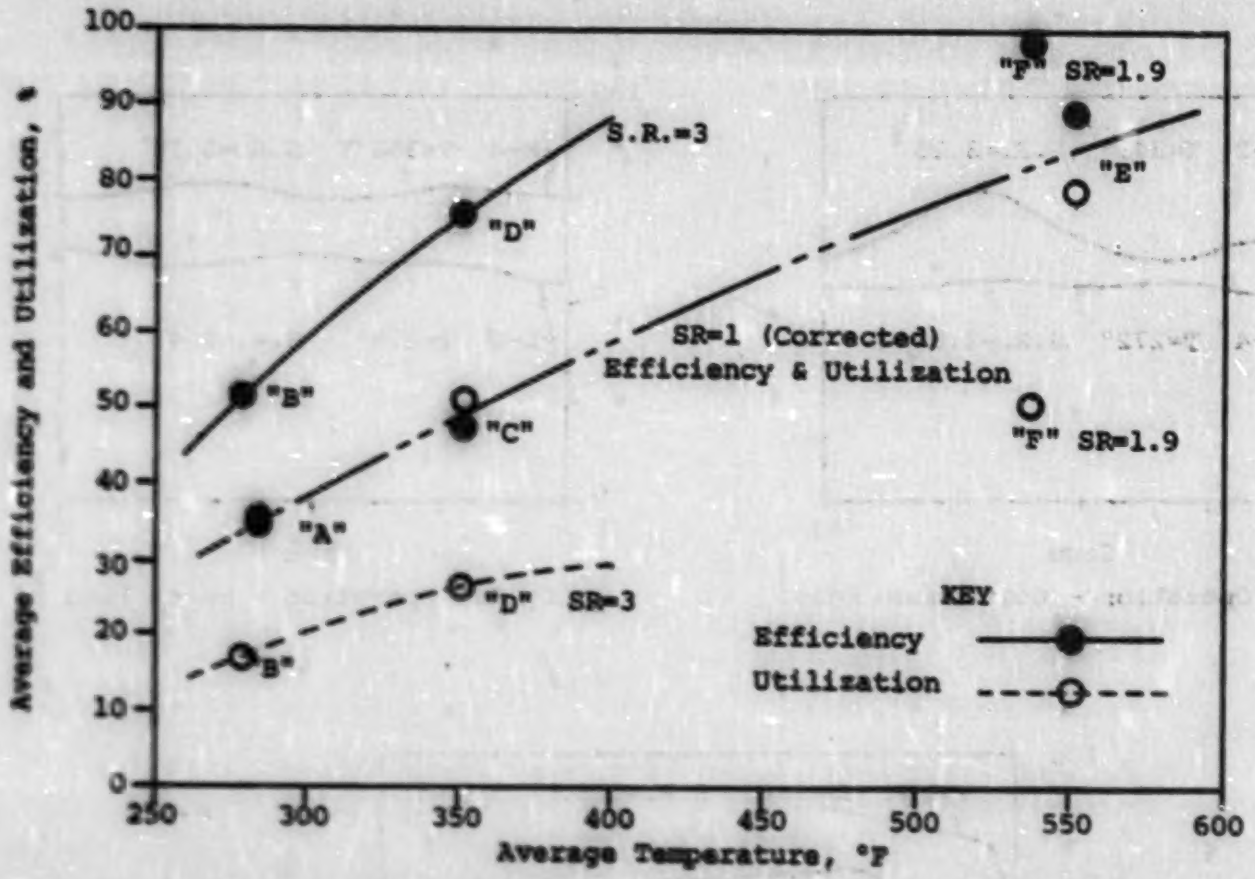


FIG. 7. EFFECT OF TEMPERATURE ON SO_2 CONVERSION EFFICIENCY - $NaHCO_3$

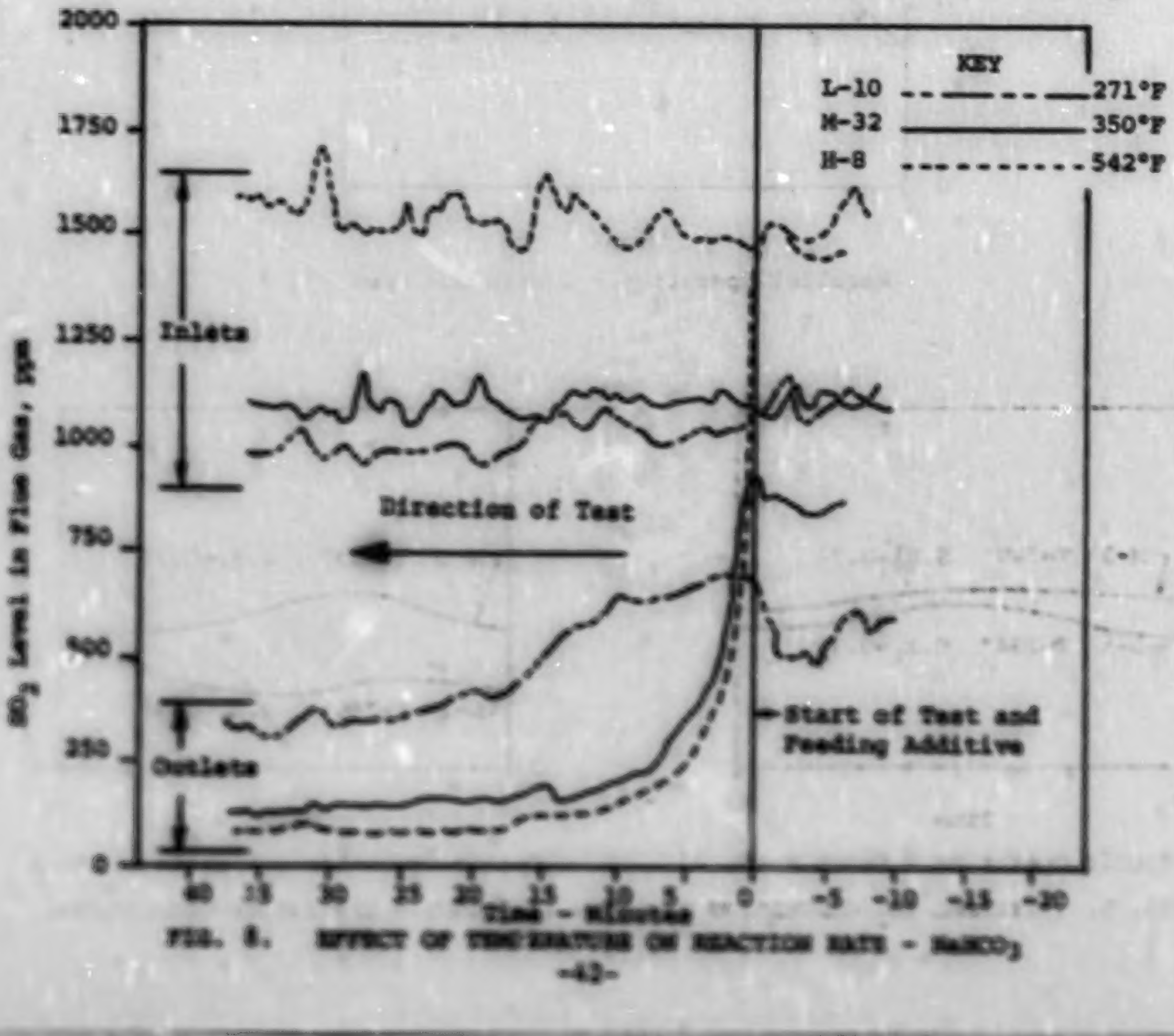


FIG. 8. EFFECT OF TEMPERATURE ON REACTION RATE - $NaHCO_3$

the agglomerated sodium bicarbonate might loosen up and react with SO_2 before it reached the decomposition temperature.

It is also of interest to note that the operating temperature has an effect on the rate of reaction. Figure 8 illustrates this point clearly. The responses of the outlet SO_2 reduction of tests M-32 and H-8 were almost instantaneous compared with that of L-10. Also, note that the magnitude of the rate of change from 271° to 350°F is much greater than that from 350° to 542°F. In a full scale unit higher temperatures would result in the advantage of higher over-all efficiency.

3. Effect of Retention Time - The purpose of these six (6) tests was to determine the effects of different retention time of the additive in the gas stream. Three (3) different feed points were used for different retention times. These were (a) solenoid valves, (b) inlet manifold, and (c) inlet duct. The details of these tests follow.

Test No.	ACFM	T(°F)	Stoich Ratio	Feed Point	Retention Time Sec.	η%	% Util.
L-9	9,900	284	3.179	Manifold	4.545	31.6	9.77
L-9A	10,000	292	2.500	Inlet Duct	5.855	31.9	13.34
M-31	10,000	352	2.800	Sol. Valves	3.744	83.2	29.52
M-32	10,250	350	2.440	Inlet Duct	5.712	85.6	35.94
H-8	8,500	542	1.860	Inlet Duct	5.787	97.5	52.2
H-9	8,700	532	1.970	Sol. Valves	4.338	98.4	49.8

Comparing the % utilization of additive, it can be seen that there is a definite advantage by injecting the additive further upstream of the filterhouse to increase the retention time. The increase in effectiveness for the first two (2) comparisons are 17.7% and 26.8%. There was no chemical analysis results available to compare the fallout with the shakedown for these tests.

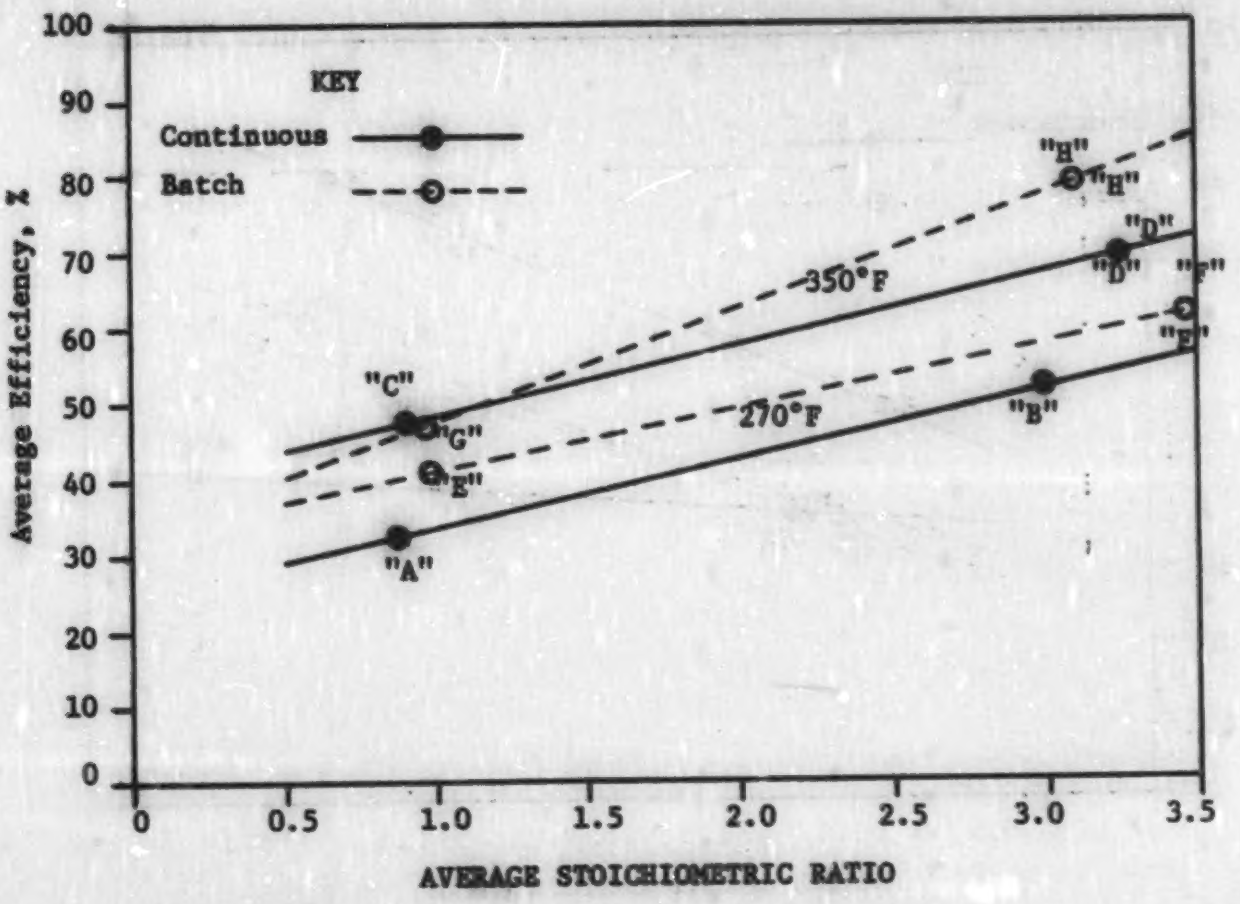
Two high temperature tests, H-8 and H-9, were performed using the inlet duct and solenoid valves respectively as the feed points. Since the temperature effect on the efficiencies were so overwhelming (97.5% and 98.4%), the effect of retention time at the higher temperatures was not distinguishable.

4. Effect of Feeding Method and House Operation - The effects of additive feeding methods, continuous or batch, on SO_2 conversion efficiency differed with the mode of house operation, cyclic or parallel. For cyclic operation, there were always 3 compartments on stream. The filter ratio, or face velocity at filter bags, of this operation is higher than that of the parallel operation for the same flow rate.

   Of the 28 low and medium temperature tests, data were analyzed by the mode of operation, cyclic or parallel. They are shown in Figures 9 and 10 respectively. Upon investigating these figures, limited conclusions can be drawn as follows:

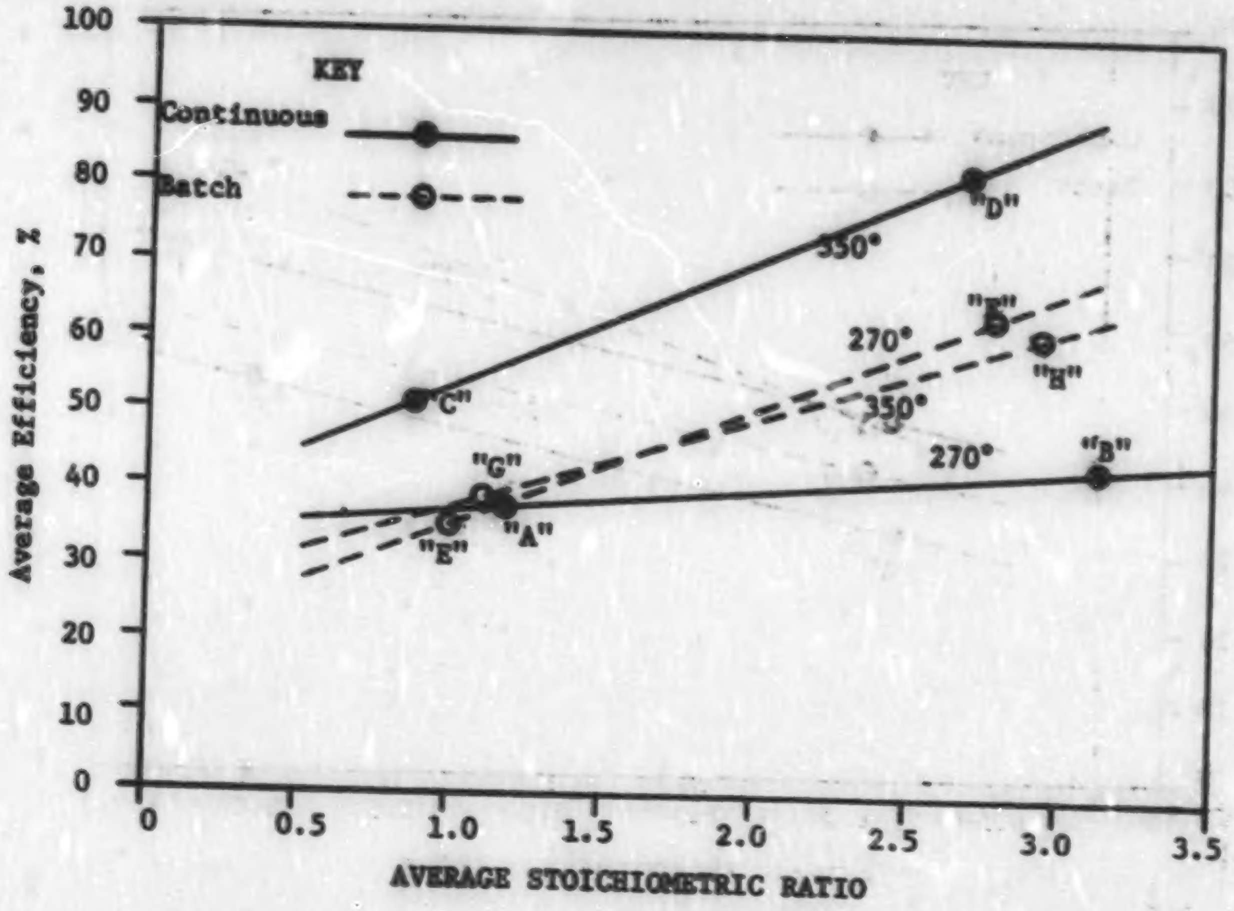
   a) Cyclic Operation - The batch feeding method appears to yield better SO_2 conversion at both temperature levels.
   b) Parallel Operation - The effect of batch feeding method on conversion efficiency at 350°F seems to negate the strong temperature effect as compared with that of the continuous feeding.

   Since the feeding methods and the modes of house operation are primary design parameters for this filterhouse application on SO_2 control, more experimental studies are required in order to derive the preference of one over the other. Table 2 shows the distribution of additive in the filterhouse. No attempt was made to analyze the effect of feeding methods on additive distribution.



Point	Test No.	Temp. (°F)	S.Ratio	η(%)	Point	Test No.	Temp. (°F)	S.Ratio	η(%)
				CONTINUOUS FEED					
A	L-1	286	0.952	24.8	C	L-3	350	0.940	53.3
	L-2	292	0.739	39.1		M-1	353	0.770	41.7
	Avg.	289	0.946	32.0		Avg.	352	0.855	47.5
B	L-4	272	2.978	52.0	D	M-2	349	3.250	69.9
				BATCH FEED					
E	L-5	284	0.976	40.4	G	M-3	349	0.936	47.9
F	L-6	275	3.425	61.3	H	M-4	354	3.097	79.0

FIG. 9. EFFECT OF FEEDING METHOD, CYCLIC OPERATION - $NaHCO_3$



Point	Test No.	Temp. (°F)	S.Ratio	η(%)	Point	Test No.	Temp. (°F)	S.Ratio	η(%)
				CONTINUOUS FEED					
A	L-7	282	1.220	29.6	C	L-13	351	0.893	56.0
	L-8	283	1.131	42.5		M-5	354	1.010	49.4
	L-14	312	1.137	39.1		M-25	349	0.885	58.1
	Avg.	292	1.163	37.1		M-26	356	0.886	52.1
						M-27	355	0.809	38.1
B	L-9	284	3.179	31.6		Avg.	353	0.897	50.7
	L-9A	292	2.500	31.9					
	L-10	271	3.657	67.7	D	M-6	350	2.790	77.5
	Avg.	282	3.112	43.7		M-31	352	2.800	83.2
						M-32	350	2.440	85.6
						Avg.	351	2.677	82.1
				BATCH FEED					
E	L-11	280	0.979	35.0	G	M-7	350	1.103	38.9
F	L-12	283	2.794	63.7	H	M-8	349	2.917	60.7

FIG. 10. EFFECT OF FEEDING METHOD, PARALLEL OPERATION - $NaHCO_3$

Table #2 - Distribution of Additive - $NaHCO_3$

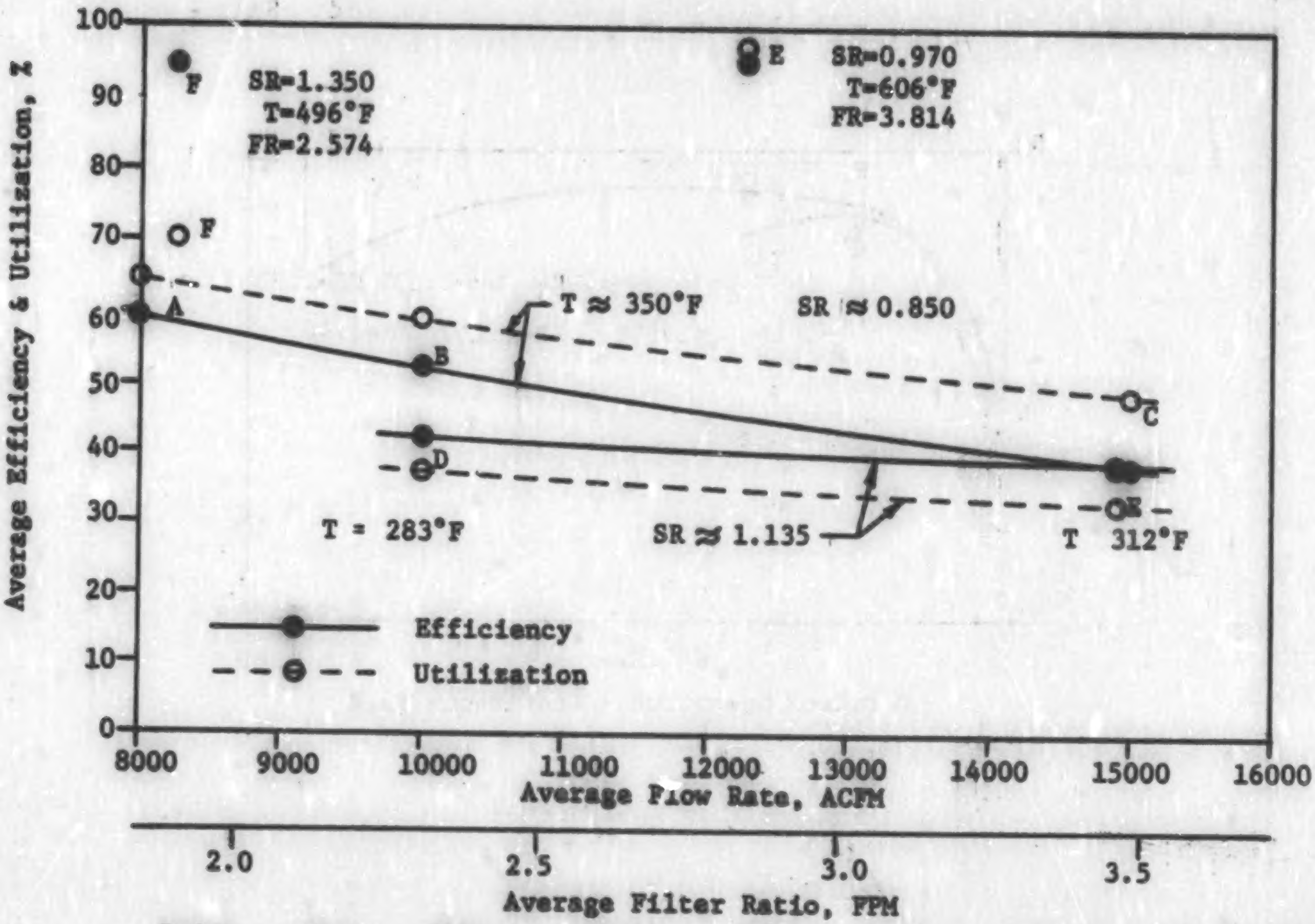
Test No.	Stoich. Ratio	Type Feed	Total # Additive	% In Fallout	% On Bags	Test %	% Utilization
L-1	0.952	Cont.	240	27.90	72.10	24.8	25.7
L-2	0.739	Cont.	510	33.14	66.86	39.1	52.3
L-3	0.987	Cont.	455	49.88	50.12	53.3	52.4
L-4	2.978	Cont.	430	58.30	41.70	52.0	18.2
L-5	0.976	Batch	350	27.71	72.29	40.4	42.0
L-6	3.425	Batch	436	89.20	10.80	61.3	17.9
L-7	1.220	Cont.	355	46.85	53.15	29.6	22.8
L-8	1.131	Cont.	532	44.59	55.41	42.5	37.0
L-9	3.179	Cont.	1370	36.75	63.25	31.6	9.77
L-9A	2.500	Cont.	990	56.44	43.56	31.9	13.34
L-10	3.657	Cont.	2025	60.43	39.57	67.7	18.06
L-11	0.979	Batch	470	40.53	59.47	35.0	35.7
L-12	2.794	Batch	690	55.25	44.75	63.7	22.8
L-13	0.893	Cont.	340	28.89	71.11	56.0	62.3
L-14	1.137	Cont.	350	58.07	41.93	39.05	33.86
M-1	0.770	Cont.	146	52.11	47.89	41.7	53.8
M-2	3.250	Cont.	440	46.67	53.33	69.9	21.3
M-3	0.936	Batch	109	55.05	44.95	47.9	51.8
M-4	3.097	Batch	396	57.89	42.11	79.0	25.5
M-5	1.010	Cont.	565	43.33	56.67	49.4	48.9
M-6	2.790	Cont.	1670	52.35	47.65	77.5	27.5
M-7	1.103	Batch	350	37.76	62.24	38.9	35.2
M-8	2.917	Batch	520	46.14	53.86	60.7	20.8
M-25	0.885	Cont.	96	38.07	61.93	59.1	64.1
M-26	0.886	Cont.	125	51.65	48.35	52.1	59.4
M-27	0.809	Cont.	135	52.66	47.34	38.1	44.2
M-31	2.800	Cont.	471	52.45	47.55	83.2	29.51
M-32	2.440	Cont.	444	39.35	60.65	85.6	35.9
H-8	1.860	Cont.	336	7.94	92.96	97.5	52.2
H-9	1.970	Cont.	351	25.50	74.50	98.4	49.8
H-10	1.350	Cont.	237	9.35	90.65	94.6	70.0
H-13	0.970	Cont.	223	21.71	78.29	85.0	87.6

5. Effect of Filter Ratio - Analyzing the data from seven tests to determine the effects of flow, the results indicate that as the flue gas filter ratio is increased, there is a decrease in SO_2 conversion and additive utilization. This effect was typical at all operating temperatures as shown in Figure 11.

In reviewing the curves in Figure 12, a pronounced difference in starting efficiencies resulting from pretest conditions is indicated. Some tests were performed immediately following a precoat of additive and the pretest shakedown had little effect on changing the efficiency. Other tests were run following a period of time when no additive was being supplied. In the latter case, the additive that was retained on the filterbags had been reacted with the SO_2 gas, and the efficiencies were much lower when the test cycle actually started. For this reason, to obtain more accurate information, the tests should only be compared following level-out of the conversion efficiency.

Comparing Tests M-25, M-26 and M-27, indications show that for the 8000 CFM and 10,000 CFM tests, the difference between SO_2 conversion efficiencies at 20 minutes after start of the tests are approximately 2%. The higher flow (15,000 ACFM) test shows a drop in efficiency but it should be noted that it has a 10% lower stoichiometric ratio. Comparing tests No's. L-8 and L-14, it can be seen that there is a definite negative effect of filter ratio on the SO_2 conversion efficiency and additive utilization effectiveness.

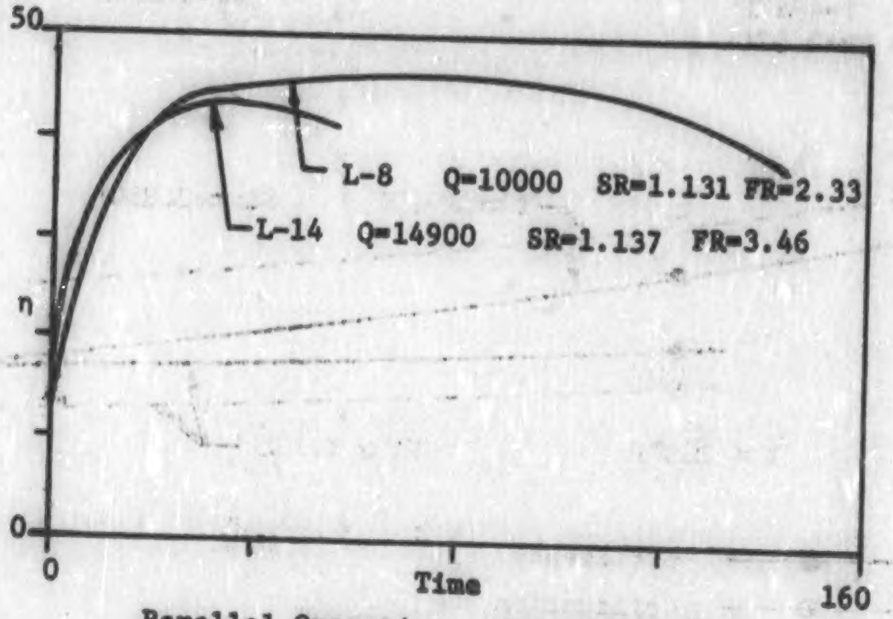
6. SO_2 Conversion Distribution in the Filterhouse - Chemical analysis of the fallout and shakedown samples of eleven tests was made to determine



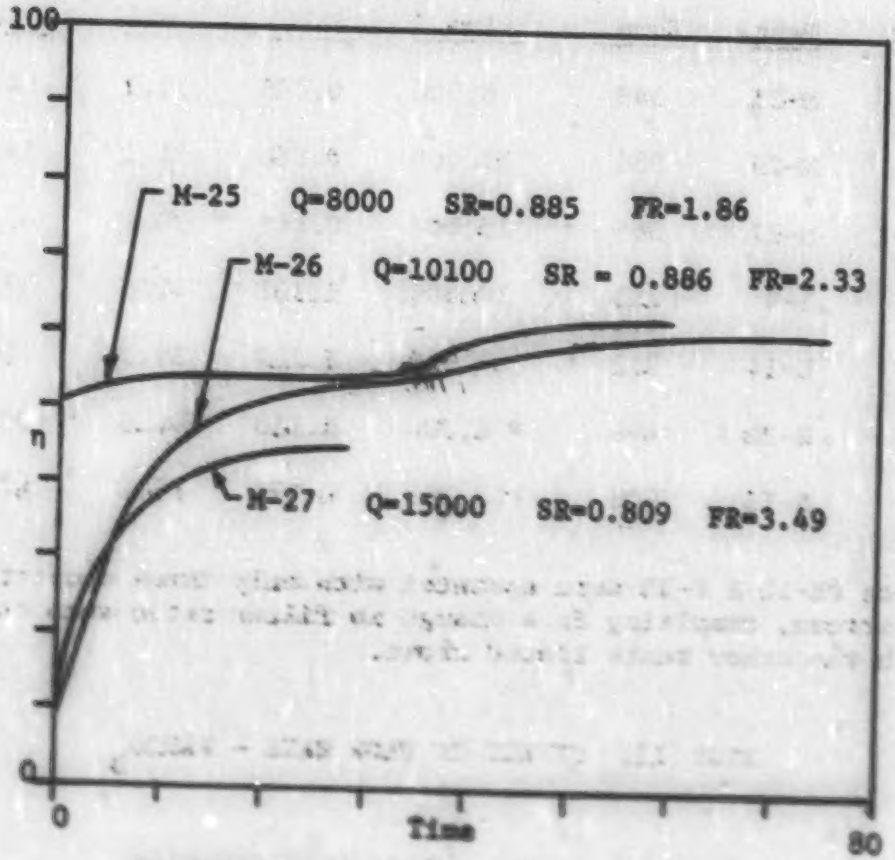
Point	Test	Temp.	Flow	S.R.	η%	% Util.	Filter Ratio
A	M-25	349	8,000	0.885	59.1	64.1	1.860
B	M-26	356	10,000	0.886	52.1	59.4	2.326
C	M-27	355	15,000	0.806	38.1	48.2	3.488
D	L-8	283	10,000	1.131	42.5	37.0	2.326
E	L-14	312	14,900	1.137	39.1	33.9	3.465
F	H-10	496	* 8,300	1.350	94.6	70.0	2.574
G	H-13	606	*12,300	0.970	85.0	87.6	3.814

*Tests #H-10 & H-13 were operated with only three compartments on stream, resulting in a change in filter ratio when compared with the other tests listed above.

FIG. 11. EFFECT OF FLOW RATE - $NaHCO_3$



Parallel Operation - Continuous Feed



Parallel Operation - Continuous Feed

FIG. 12. TYPICAL SO_2 CONVERSION EFFICIENCY HISTORY - FLOW RATE COMPARIS
$NaHCO_3$

the SO_2 conversion distribution in the filterhouse, or where the major portion of the chemical reaction of SO_2 conversion takes place. For convenience, the percentage of SO_2 conversion in suspension instead of that on the bags is considered here. It was found that the operating temperature of the filterhouse has a significant effect on conversion distribution, as shown in Figure 13.

Due to the limited data available for more detailed analysis, no attempt was made to seek any form of correlation among the data points. However, it is apparent that the reaction between the SO_2 vapor and the $NaHCO_3$ particles taking place in the gas stream increases linearly with the flue gas temperature. It is also interesting to note that the stoichiometric ratio has little effect on the conversion distribution. Other variables such as feeding method and house operation might have some effects, but no conclusive derivation could be made due to insufficient data available.

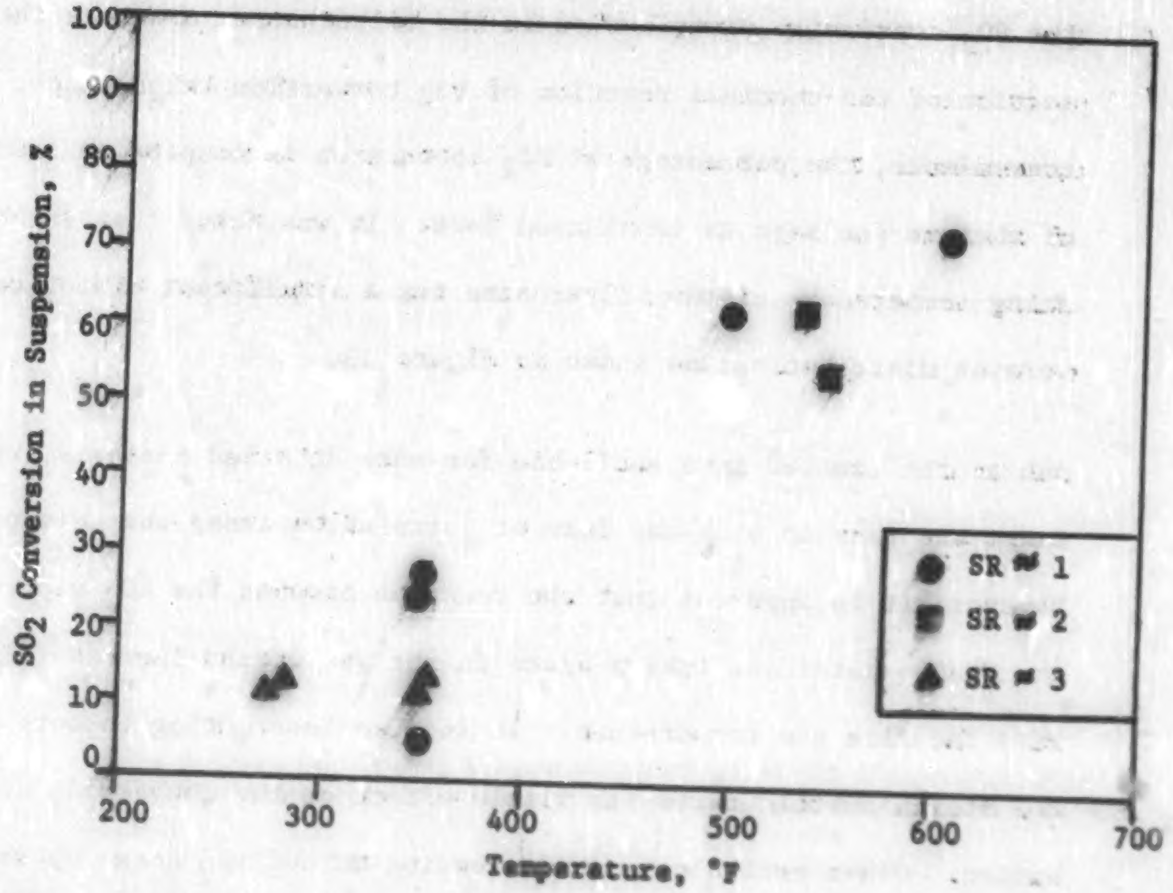
7. Compartment Distribution - Table No. 3 contains percentage distribution between the four compartments of total additive plus flyash that was collected in the fallout and shakedown samples.

Reviewing the fallout distribution, the following can be seen:

a) Generally there is a higher fallout in the compartments with higher flow rates.

b) The flow in "A" compartment is the lowest in most tests and it also has the lowest average percentage of fallout.

The stoichiometric ratio had no apparent effect on compartment distribution with either fallout or shakedown. In some cases, there was



Test No.	Flow ACFM	Stoich. Ratio	Temp. °F	House Operation	Feed Method	SO_2 Conv. Eff. %	SO_2 Conversion In Suspension %
L-4	9800	2.978	272	Cyclic	Cont.	52.0	11.13
L-12	10250	2.794	283	Parallel	Batch	63.7	13.31
M-4	10250	3.097	354	Cyclic	Batch	79.0	13.85
M-6	10250	2.790	350	Parallel	Cont.	77.5	10.77
L-3	10125	0.987	350	Cyclic	Cont.	53.3	27.27
M-3	10300	0.936	349	Cyclic	Batch	47.9	24.93
M-7	10250	1.103	350	Parallel	Batch	38.9	5.09
H-8	8500	1.860	542	Parallel	Cont.	97.5	34.71
H-9	8700	1.970	532	Parallel	Cont.	98.4	62.36
H-10	8300	1.350	496	Parallel	Cont.	94.6	62.13
H-13	12300	0.970	606	Parallel	Cont.	85.0	71.73

FIG. 13. SO_2 CONVERSION IN SUSPENSION - $NaHCO_3$

Table 3 - Compartment Distribution of Ash and Additive Samples

Test No.	Compartment Fallout (%) A	B	C	D	Compartment Shakedown (%) A	B	C	D
L-1	8.9	35.6	33.2	22.2	9.0	39.3	23.6	28.1
L-2	6.5	25.0	38.7	29.8	15.2	26.9	28.3	29.6
L-3	10.0	16.1	17.4	56.0	20.6	25.7	22.7	31.0
L-4	24.8	32.3	22.4	20.5	25.6	29.1	17.1	28.2
L-5	31.4	16.3	26.7	25.6	30.2	22.2	23.8	23.8
L-6	28.2	21.6	17.5	32.7	31.3	20.3	24.2	24.2
L-7	10.8	34.6	35.0	19.6	17.1	24.8	36.1	22.0
L-8	9.5	30.0	37.3	23.2	23.7	20.9	31.9	23.5
L-9	14.3	36.3	28.1	21.3	27.7	24.8	25.8	21.7
L-9A	16.5	33.5	34.0	16.0	25.0	25.5	26.9	22.6
L-10	30.0	41.6	17.9	10.5	37.3	10.5	11.0	41.7
L-11	6.8	43.0	42.5	7.7	12.6	42.1	24.3	21.0
L-12	15.8	37.2	29.3	17.7	14.7	43.7	28.2	13.4
L-13	6.4	13.8	27.5	52.3	19.7	25.2	28.1	27.1
L-14	16.4	38.5	41.8	3.3	22.8	29.1	32.8	15.3
M-1	14.6	19.1	30.3	36.0	25.0	21.9	32.8	15.3
M-2	35.8	34.0	3.3	29.6	31.1	31.1	9.1	28.7
M-3	25.7	21.4	28.6	24.3	24.6	26.2	26.1	23.0
M-4	26.4	21.3	27.3	25.0	28.0	20.0	26.2	23.0
M-5	11.4	18.9	32.5	38.2	24.9	24.9	25.5	24.7
M-6	32.3	42.7	11.0	14.0	22.4	33.0	18.8	25.8
M-7	22.4	56.0	8.0	13.6	26.7	27.3	21.6	24.4
M-8	20.8	63.7	3.9	11.6	20.3	42.5	17.1	19.9
M-25	28.1	22.5	22.5	26.9	25.0	15.6	21.9	37.5
M-26	20.0	28.2	28.6	23.2	22.1	19.5	29.2	29.2
M-27	13.9	30.5	25.0	30.5	22.3	21.2	29.6	26.9
M-31	36.3	27.3	14.8	21.6	10.6	31.9	27.7	29.8
M-32	31.9	25.8	24.7	17.6	21.5	24.6	28.9	25.0
Average	19.8	30.9	25.4	23.0	22.8	26.8	25.1	25.3
B-8	Off-stream	9.8*	41.2	49.0	Off-stream	0*	33.3	66.7
B-9	Off-stream	19.2	48.3	32.5	Off-stream	22.5	38.2	39.3
B-10	Off-stream	23.3	20.9	55.8	Off-stream	25.0	29.2	45.8
B-11	Off-stream	40.5	37.9	21.6	Off-stream	34.6	38.5	26.9
Average	——	27.7	35.7	36.6	——	27.4	35.3	37.3

*Hopper partially plugged--Test B-8 not included in average.

apparently poor distribution of the additive and flyash entering some compartments as the percentage is less for some compartments for both fallout and shakedowns. (Ref. L-1A; L-2A, and M-2C) In cases, there was no correlation between the fallout and shakedown samples. [Ref. L-10(B,D); L-13(A,D); M-7(C); M-8(C); and M-31(A)]. In some tests, the weighing of the samples was not satisfactory. It is also known that some unknown amount of the on-bag material was carried out with the deflation gas. For this reason the tables are included as reference only with no conclusions being made.

8. Specific Resistance of the Filtercake - Since the mechanism of the build-up of filtercake is largely dependent upon the characteristics of the filter fabric, test results of the same set of bags were exclusively considered. Plots in Fig. 14 show that

a) Temperature has little effect on K value

b) Stoichiometric ratio has a significant effect. The higher the rate of additive feeding, the lower the specific resistance. In other words, stoichiometric ratio has a stronger effect on the filtercake building than that on the pressure drop across the filter.

c) According to the definition of K, $K = \frac{(\Delta p_{dirty} - \Delta p_{clean})}{(FR)(W)}$, where the Δp's are virtually proportional to the square of the face velocity, or filter ratio, K is, therefore, a strong function of filter ratio. The higher the filter ratio, the higher the specific resistance.

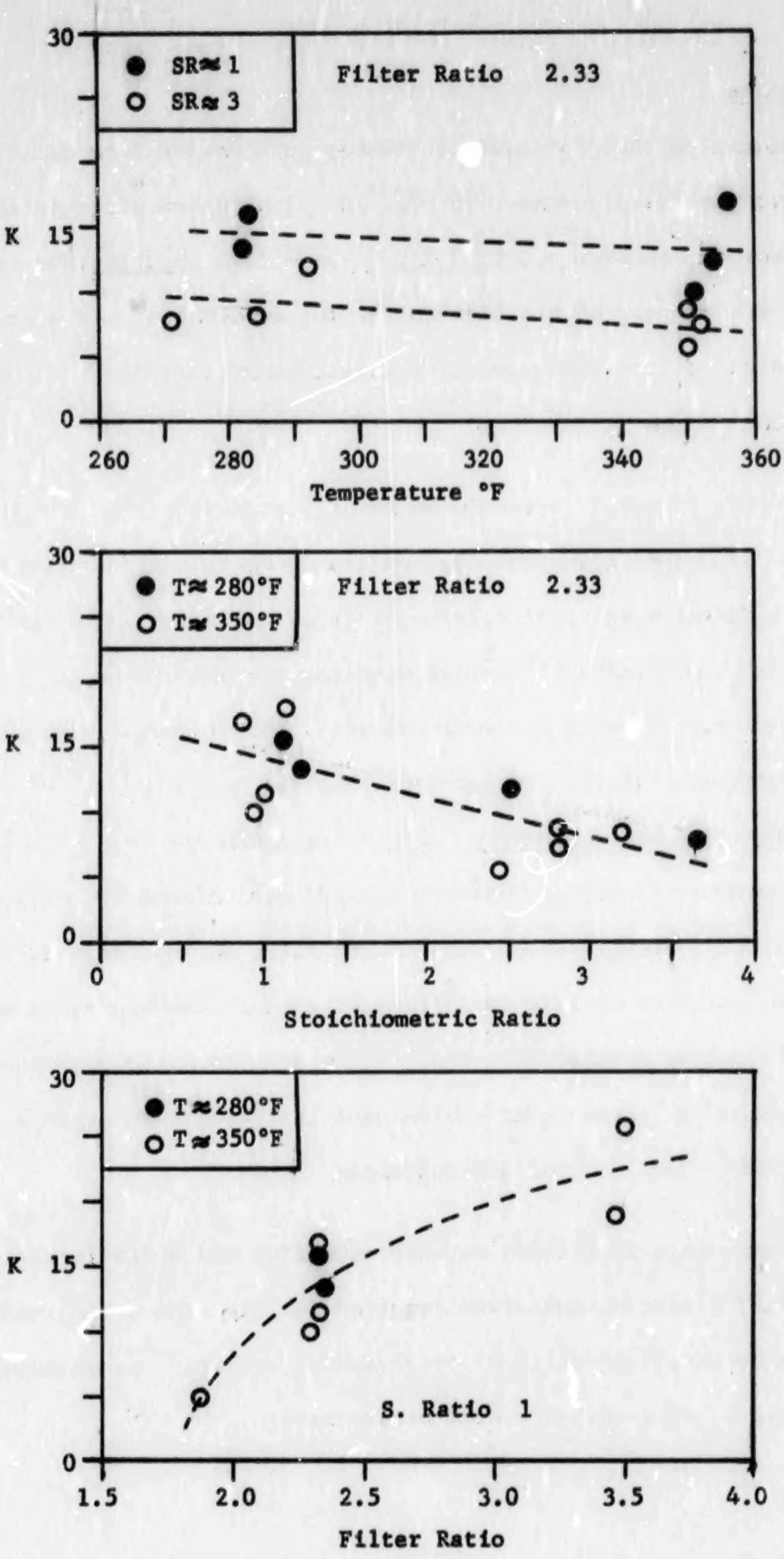


Fig. 14. - Specific Resistance of Filter cake - $NaHCO_3$

B) Nahcolite:

The nahcolite used for these tests was in a powder form and the particle size was analyzed as shown in Fig. 15. Its sodium bicarbonate content was found at an average of 69.71%. The 30.29% impurity was considered inert and has no contribution to the SO_2 conversion. As a practice, only the weight of the $NaHCO_3$ was reflected in the calculation of additive utilization.

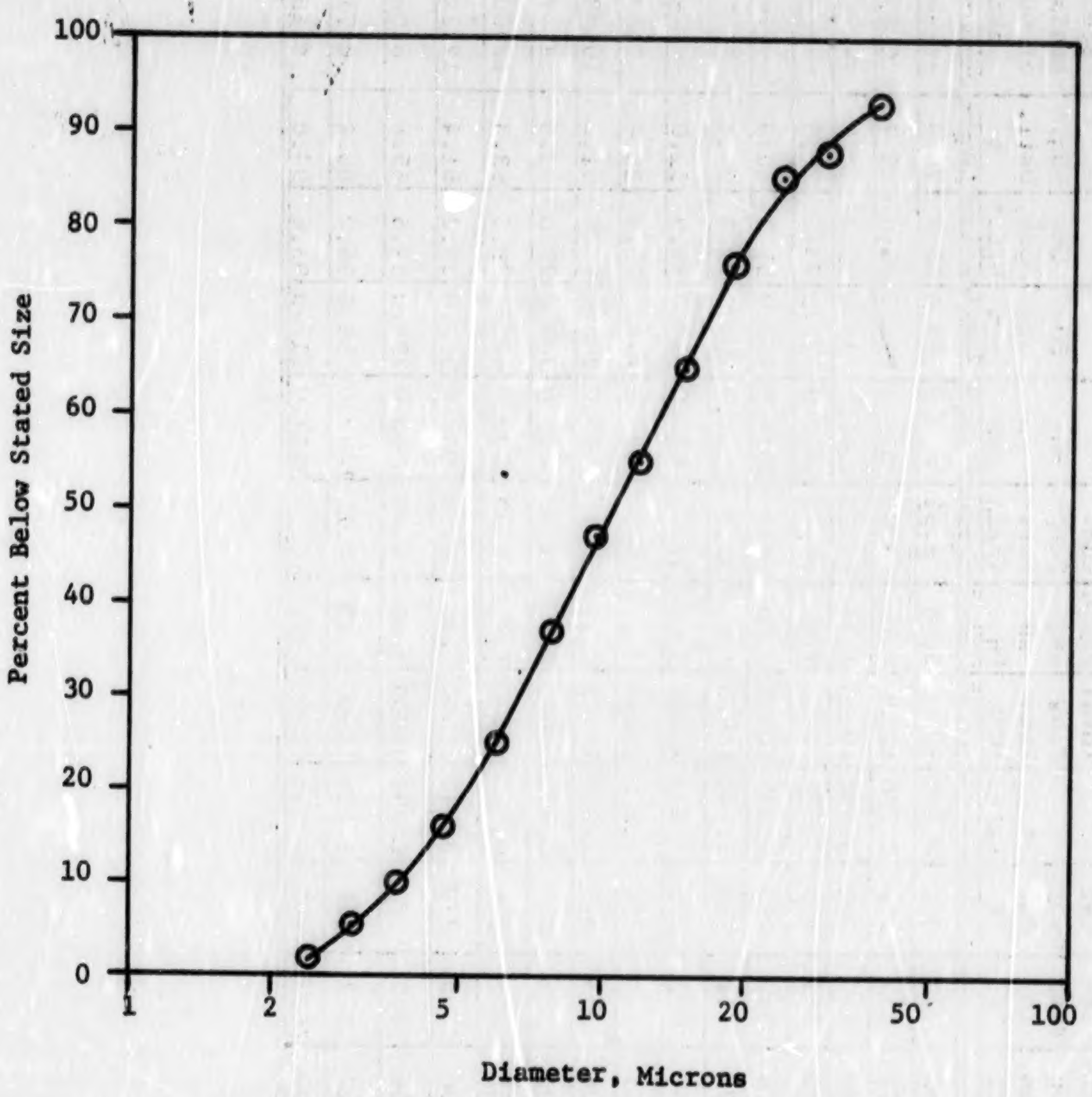
There were 15 tests performed on the filterhouse using this powdered nahcolite as the additive for SO_2 conversion under various operating conditions. Measurements and results of these tests are summarized as shown in Table 4. Effects of various operating parameters on SO_2 conversion efficiency were studied and compared with that of sodium bicarbonate whereever possible. It is presented as follows:

1. Effect of Stoichiometric Ratio - Averaging the data from 15 tests, 5 points of average temperatures and stoichiometric ratios are obtained. Effects of stoichiometric ratio on SO_2 conversion efficiency and additive utilization effectiveness can be observed from Fig. 16. It clearly demonstrates that SO_2 conversion efficiency can be increased by increase of stoichiometric ratio at an expense of losing additive utilization effectiveness.

   There was a difference between nahcolite and sodium bicarbonate in total weight of additives required for the same stoichiometric ratio. Nahcolite of a purity of 69.7% $NaHCO_3$ requires approximately 43.5% more by weight than sodium bicarbonate.

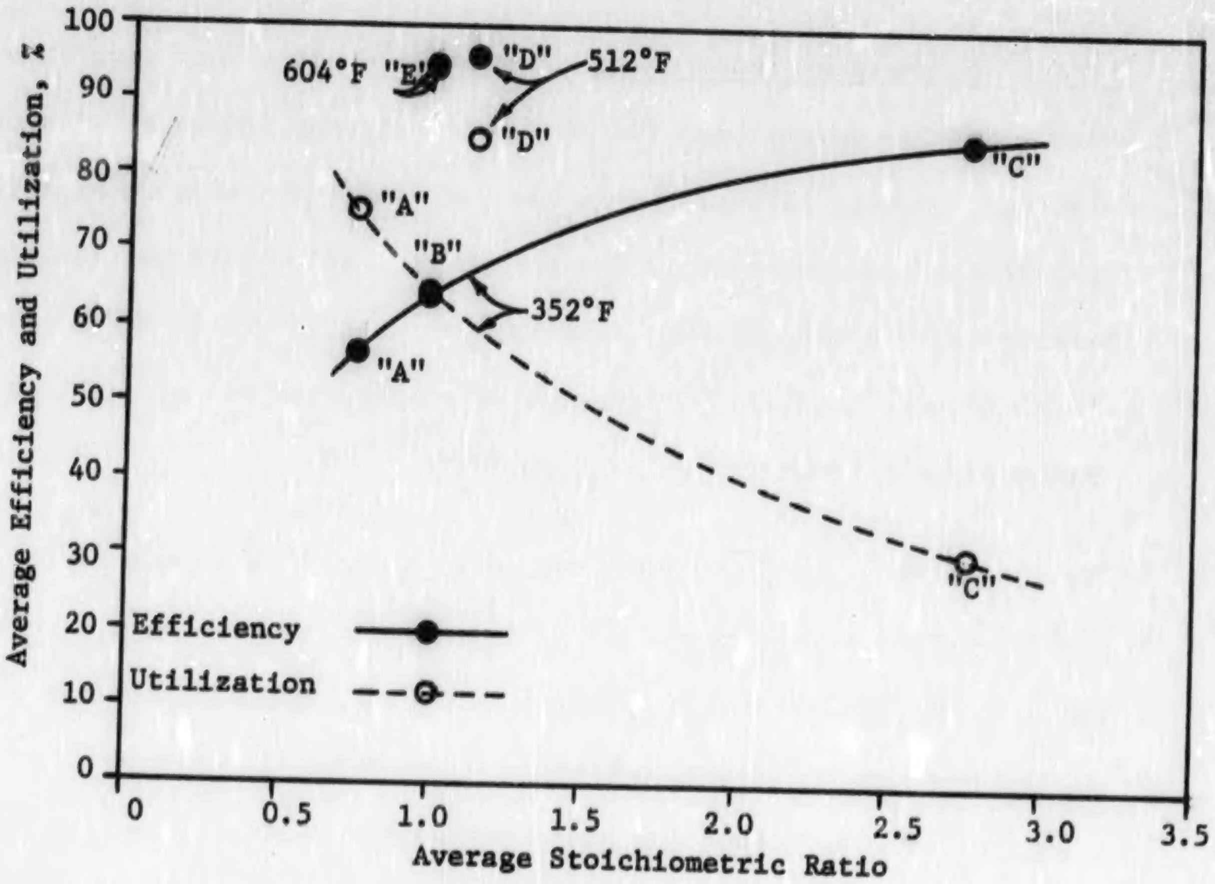
TABLE 4. SUMMARY OF NAHCOLITE TESTS

Test No.	Baghouse Operation	Feed Method	Cycle Time Min.	Retention Time Sec.	Gas Temp. In °F	Gas Temp. Out °F	Stoic Ratio	Total Flow Rate ACFM	House Avg. ΔP "H_2O	Add. Feed Rate #/Min	SO_2 In ppm	SO_2 Out ppm	SO_2 Conv. Eff.%	Add. Util. %	Spec. Resist. of Dust Cake	Conv. on Bags %
M-9	Cyclic	Cont.	40	2.780	350	305	0.820	10100	5.08	2.92	870.2	303.8	65.1	79.9	------	------
M-10	Parallel	Cont.	60	2.674	352	302	0.750	10500	4.15	2.97	930.0	316.0	66.0	89.7	6.177	------
M-11	Cyclic	Cont.	40	2.740	353	300	2.640	10250	4.76	11.88	1080.0	93.0	91.4	34.6	------	------
M-12	Cyclic	Batch	40	2.740	354	305	0.958	10250	4.46	14.35	829.0	222.0	73.3	76.5	------	------
M-13	Parallel	Batch	60	2.674	350	298	0.927	10500	3.80	24.4	1054.0	467.0	55.7	60.3	------	78.91
M-14	Parallel	Batch	60	2.674	352	288	2.740	10500	4.10	39.0	1084.0	300.0	72.3	26.4	------	100.00
M-15	Cyclic	Batch	40	2.780	352	291	2.882	10100	4.68	22.2	845.0	91.0	89.3	31.0	------	92.85
M-16	Parallel	Cont.	60	3.653	350	295	2.800	10250	4.13	10.8	925.0	128.0	86.2	30.8	------	43.85
M-23	Parallel	Cont.	45	2.496	355	316	1.080	15000	7.30	5.1	780.0	266.0	66.0	61.2	2.697	90.84
M-24	Parallel	Cont.	65	4.992	352	285	0.802	7500	2.55	1.98	810.0	203.0	75.0	93.5	10.884	92.51
M-28	Parallel	Cont.	37	2.455	305	275	0.607	15250	7.23	4.40	1100.0	677.0	38.5	63.3	4.574	75.87
M-29	Parallel	Cont.	38	2.496	296	270	0.742	15000	7.35	4.58	941.0	582.0	38.2	51.4	12.800	93.76
M-30	Parallel	Cont.	50	2.496	352	277	0.954	15000	7.20	4.42	760.0	285.0	62.5	65.6	12.118	90.96
H-11	Parallel	Cont.	60	5.927	512	358	1.129	8300	1.43	4.75	1492.0	58.0	96.2	85.2	8.089	85.48
H-12	Parallel	Cont.	49	3.999	604	465	0.995	12300	3.72	6.94	1827.0	117.0	93.6	94.0	0.710	26.57



(This curve was prepared by NAPCA personnel on 13 June 1969.)

FIG. 15. PARTICLE SIZE ANALYSIS - NAHCOLITE



Test No.	S.R.	η	% Util.
POINT "A" (352°F)			
M-9	0.820	65.1	79.9
M-10	0.750	66.0	89.7
M-24	0.802	75.0	93.5
M-28	0.607	38.5	63.3
M-29	0.742	38.2	51.4
Average	0.744	56.6	75.6
POINT "C" (352°F)			
M-11	2.640	91.4	34.6
M-14	2.740	72.3	26.4
M-15	2.882	89.3	31.0
M-16	2.800	86.2	30.8
Average	2.765	84.8	30.7

Test No.	S.R.	η	% Util.
POINT "B" (352°F)			
M-12	0.958	73.3	76.5
M-13	0.927	55.7	60.3
M-23	1.080	66.0	61.2
M-30	0.954	62.5	65.6
Average	0.978	64.4	65.9
POINT "D" (512°F)			
H-11	1.129	96.2	85.2
POINT "E" (604°F)			
H-12	0.995	93.6	94.0

FIG. 16. EFFECT OF STOICHIOMETRIC RATIO, NAHCOLITE

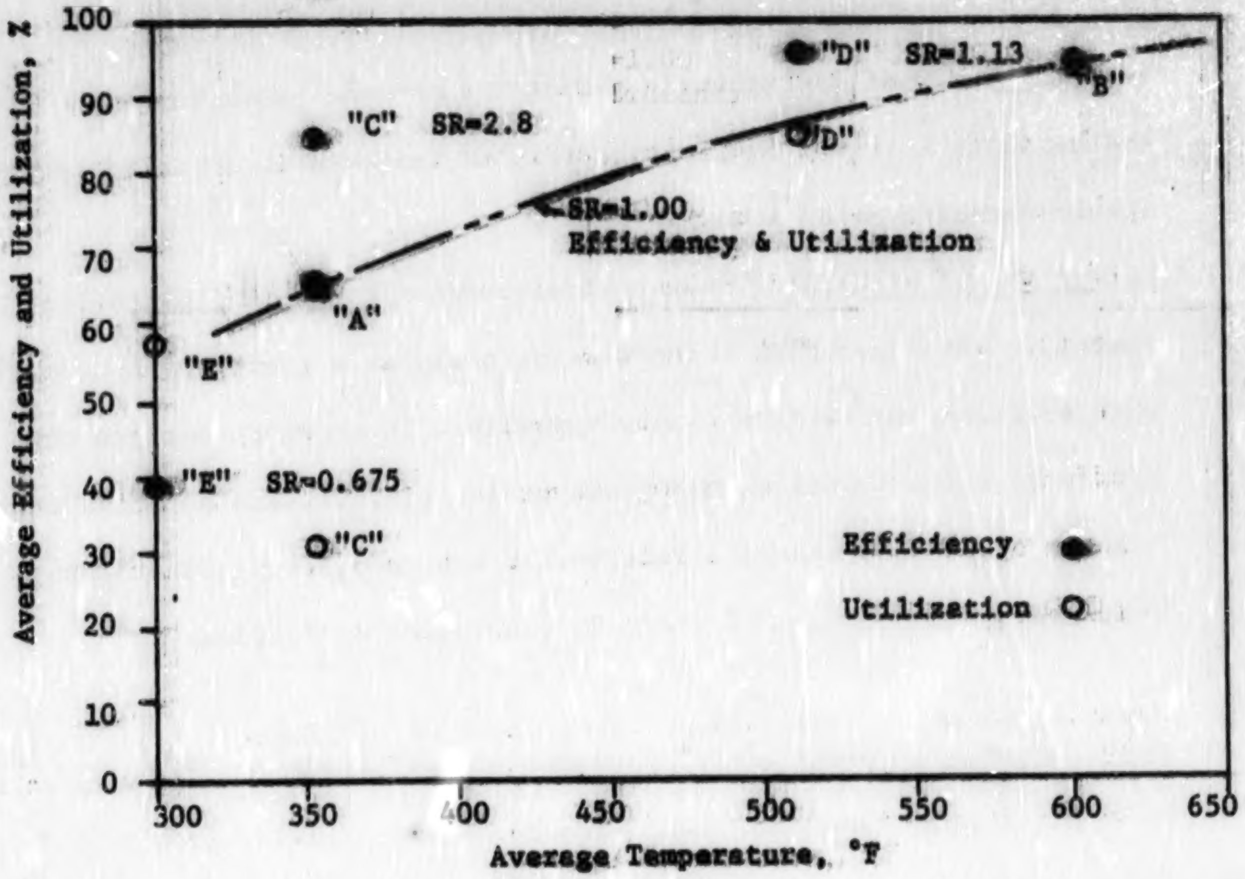
2. **Effect of Operating Temperature** - Temperature has a very significant effect on SO_2 conversion. The percent conversion increases with temperature. This is illustrated in Fig. 17. As there were no high temperature tests performed at a Stoichiometric ratio of three, the comparison can be made on test results with Stoichiometric ratio of one. It can be seen that at 600°F operating temperature the additive utilization effectiveness can be as high as 94%.

   Two tests (M-28 and M-29) were conducted in the 300°F range with stoichiometric ratio around 0.7. It is of interest to note that they had a rather high additive utilization effectiveness as compared with their SO_2 conversion efficiencies.

3. **Effect of Feeding Method and House Operation** - Four (4) sets of tests can be used to compare the two (2) feeding methods used. All tests were in the 350° temperature range.

Test No.	Flow ACFM	Stoich. Ratio	Type Feed	% Efficiency	% Additive Utilization
		PARALLEL HOUSE OPERATION			
M-10	10500	0.750	Cont.	66.0	89.7
M-13	10500	0.927	Batch	55.7	60.3
M-16	10250	2.800	Cont.	86.2	30.8
M-14	10500	2.740	Batch	72.3	26.4
		CYCLIC HOUSE OPERATION			
M-9	10100	0.820	Cont.	65.1	79.9
M-12	10250	0.958	Batch	73.3	76.5
M-11	10250	2.640	Cont.	91.4	34.6
M-15	10100	2.882	Batch	91.0	31.0

From the above, it can clearly be seen that the type of house operation has some effect. When operating parallel, there is a definite



Test No.	Temp.	S.R.	η	% Util.
		POINT"A"		
M-12	354	0.958	73.3	76.5
M-13	350	0.927	55.7	60.3
M-23	355	1.080	66.0	61.2
M-30	352	0.954	62.5	65.6
Avg.	353	0.978	64.4	65.9
		POINT "B"		
H-12	604	0.995	93.6	94.0
		POINT "D"		
H-11	512	1.129	96.2	85.2

Test No.	Temp.	S.R.	η	% Util.
		POINT "C"		
M-11	353	2.640	91.4	34.6
M-14	352	2.740	72.3	26.4
M-15	352	2.882	89.3	31.0
M-16	350	2.800	86.2	30.8
Avg.	352	2.765	84.8	30.7
		POINT "E"		
M-28	305	0.607	38.5	63.3
M-29	296	0.742	38.2	51.4
Avg.	300	0.675	38.4	57.4

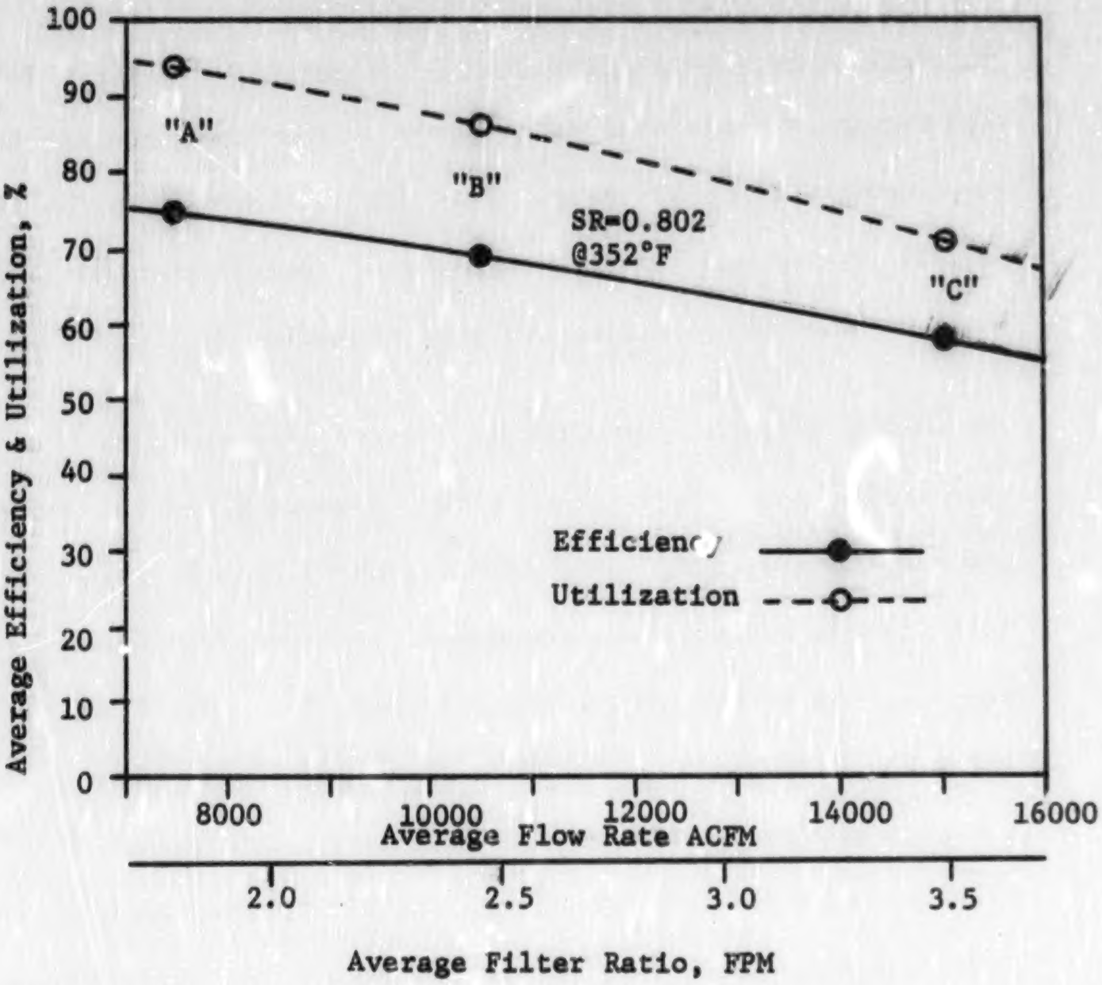
FIG. 17. EFFECT OF TEMPERATURE, NAHCOLITE

advantage to feed continuously rather than by the batch method. When the house is operated cyclic, the results indicate no decisive advantage to either type of feed.

4. **Effect of Filter Ratio** - Upon reviewing the fifteen (15) nahcolite tests, it was found that there were no tests as a group having the flow rate or filter ratio as the only variable. In order to analyze the effect of filter ratio on SO_2 conversion efficiency and additive utilization, three tests were selected with some necessary adjustments. They are tests M-10, M-24, and M-30 and listed as follows:

Test No.	Baghouse Operation	Feed Method	Temp. °F	Stoich. Ratio	Flow ACFM	Filter Ratio	η%	Util. %
M-24	Parallel	Cont.	352	0.802	7500	1.744	75.0	93.5
M-10	Parallel	Cont.	352	0.750	10500	2.442	66.0	89.7
M-30	Parallel	Cont.	352	0.954	15000	3.488	62.5	65.6

It can be seen that their stoichiometric ratios are far apart while other operating parameters are identical. As illustrated in an earlier section, the effect of stoichiometric ratio is clearly shown in Fig. 16. Assuming linear interpolation applies, the conversion efficiency and utilization effectiveness of tests M-10 and M-30 may be adjusted for stoichiometric ratio 0.802. They are listed and plotted in Fig. 18 on the following page. It is evident that nahcolite behaved similarly as sodium bicarbonate. The filter ratio had a negative effect on the SO_2 conversion efficiency and additive utilization effectiveness.



Point	Test No.	Flow ACFM	Filter Ratio	Temp. °F	Stoich. Ratio	η %	% Util.
A	M-24	7500	1.744	352	0.802	75.0	93.5
B	M-10	10500	2.442	352	0.802*	68.3*	86.0*
C	M-30	15000	3.488	352	0.802*	57.6*	71.0*

*Data were adjusted for stoichiometric ratio 0.802.

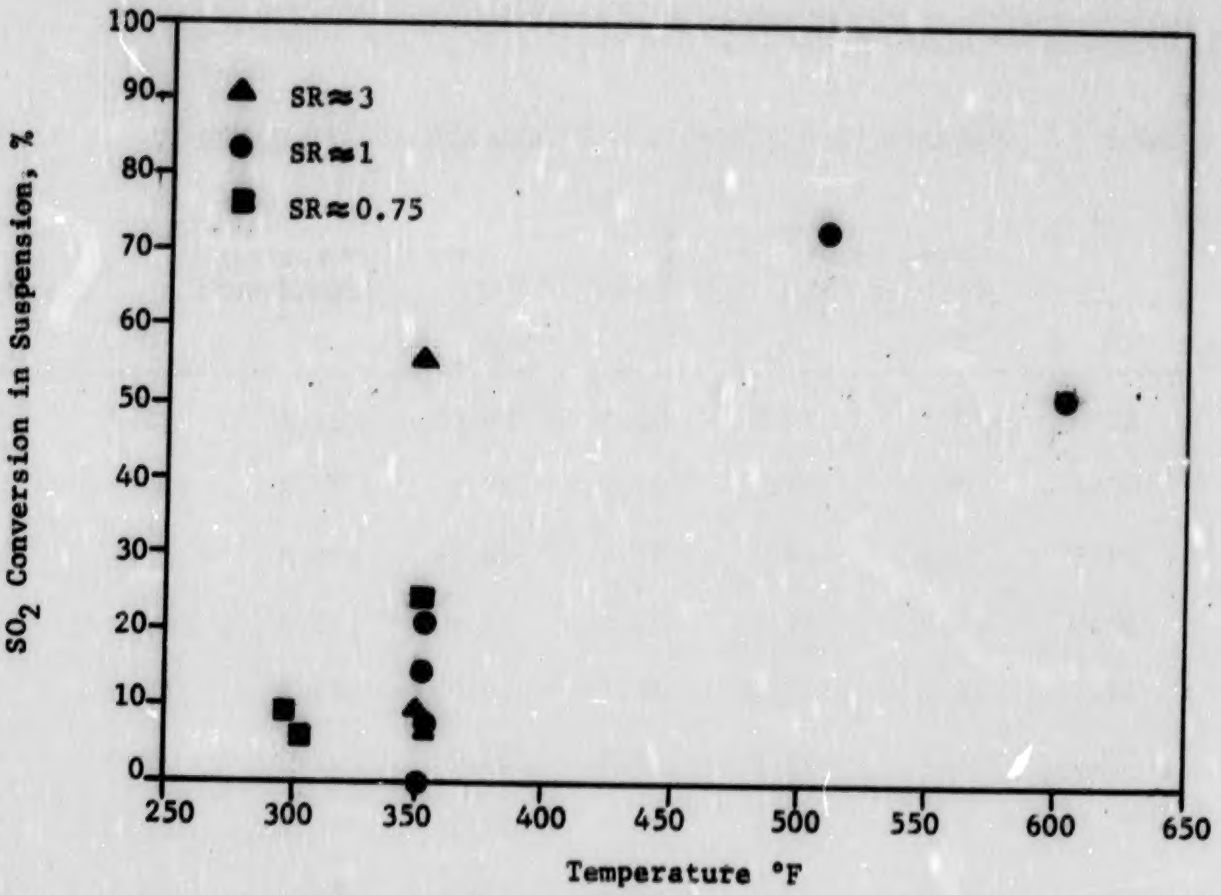
FIG. 18. EFFECT OF FILTER RATIO - NAHCOLITE

5. SO_2 Conversion Distribution in the Filterhouse - The percentage of SO_2 conversion in suspension as compared to that taking place on filterbags was calculated for 12 tests. They are listed and plotted in Fig. 19. No attempt was made to seek any form of correlation among data points. However, some observations are made as follows:

The higher flow rate resulted in a lower percentage of the conversion in the gas stream. This effect appears to be independent of the gas temperature (Ref. Tests M-12 vs. M-30). As the stoichiometric ratio of the additive was increased, the % of SO_2 conversion taking place in suspension also increased (Ref. Tests #M-13 vs. M-14 and Tests #M-12 vs. M-15). As the temperature of the flue gas is increased, a higher percentage of the SO_2 conversion takes place while the additive is in the gas stream. Comparing cyclic operation with parallel operation when feeding by the batch method, the cyclic operation results in a higher percentage of the SO_2 conversion taking place in the gas stream (Ref. M-14 vs. M-15). There was no available chemical data to compare house operation with continuous feeding of the additive.

6. Compartment Distribution - Table 5 contains the compartment distribution of total additive plus flyash that was collected in the fallout and shakedown samples. The pattern followed that of sodium bicarbonate. That is, the compartments with a higher percentage of gas flow had a higher percentage of the fallout and shakedown distribution.

All the "M" series tests were fed through the solenoid valves. The problems encountered using this feed point could be the cause of non-



Test No.	Flow ACFM	Filter Ratio	Stoich. Ratio	Inlet Temp. °F	House Oper.	Type Feed	% SO_2 Conv. In Gas
			Average Stoichiometric Ratio = 0.75 @ 350°F				
M-28	15250	3.547	0.607	305	Parallel	Cont.	6.24
M-29	15000	3.488	0.742	296	Parallel	Cont.	9.04
			Average Stoichiometric Ratio = 0.75 @ 350°F				
M-24	7500	1.744	0.802	352	Parallel	Cont.	24.13
			Average Stoichiometric Ratio = 1.0 @ 350°F				
M-12**	10250	3.178	0.958	354	Cyclic	Batch	21.09
M-13	10500	2.442	0.927	350	Parallel	Batch	0.00
M-23	15000	3.488	1.080	355	Parallel	Cont.	7.49
M-30	15000	3.488	0.954	352	Parallel	Cont.	14.52
			Average Stoichiometric Ratio = 3.0 @ 350°F				
M-14	10500	2.442	2.740	352	Parallel	Cont.	7.15
M-15**	10100	3.132	2.882	352	Cyclic	Batch	56.15
M-16	10250	2.384	2.800	350	Parallel	Cont.	9.16
			Average Stoichiometric Ratio = 1.0 @ 550°F				
H-11	8300*	2.574	1.129	512	Parallel	Cont.	73.43
H-12	12300*	3.814	0.995	604	Parallel	Cont.	49.04

*Three Compartment Operation
**Cyclic House Operation

Fig.19. SO_2 Conversion in Suspension - Nahcolite

TABLE 5. COMPARTMENT DISTRIBUTION OF ASH AND ADDITIVE SAMPLES

	Compartment Fallout (%)				Compartment Shakedown (%)			
Test No.	A	B	C	D	A	B	C	D
M-9	23.5	23.5	29.5	23.5	26.0	27.6	25.2	21.2
M-10	60.0	0*	13.3	26.7	18.8	27.8	30.3	23.1
M-11	25.9	19.8	18.7	35.6	26.8	26.8	25.9	20.5
M-12	20.3	25.4	30.5	23.8	18.6	15.3	31.4	34.7
M-13	14.7	22.1	47.1	16.1	16.0	29.0	27.3	17.7
M-14	18.1	52.2	12.6	17.1	24.4	37.3	9.0	29.3
M-15	15.7	7.0	40.4	36.9	21.7	25.2	30.1	23.0
M-16	15.2	10.6	25.8	48.4	14.1	14.7	30.4	40.8
M-23	16.4	27.0	33.6	23.0	19.3	29.5	21.0	30.2
M-24	27.5	23.5	21.5	27.5	25.5	17.6	27.5	29.4
M-28	17.4	27.2	34.8	20.6	13.5	29.1	30.3	27.1
M-29	20.5	29.5	38.5	11.5	21.0	22.2	32.9	23.9
M-30	18.3	30.1	35.5	16.1	22.4	16.4	31.3	29.9
Average	22.6	22.9	29.4	25.1	20.6	24.5	27.9	27.0
H-11	Off-Stream	34.3	25.7	40.0	Off-Stream	34.1	34.1	31.8
H-12	Off-Stream	55.2	32.5	12.3	Off-Stream	38.6	32.7	28.7
Average	-----	44.8	29.1	26.1	-----	36.4	33.4	30.2

*Scales Not Accurate

consistant data. Also when the sample weights were low (less than 15 pounds), the accuracy of the scales was not adequate to obtain true distribution. However, changes in stoichiometric feed rates have no noticeable effect on the compartment distribution.

7. Specific Resistance of the Filtercake - The specific resistance of the filtercake of nahcolite has the characteristics similar to that of sodium bicarbonate. Plots in Fig.20 show that
   a) Temperature has little effect on K value,
   b) Increasing the stoichiometric ratio decreases the specific resistance of the filtercake,
   c) As the filter ratio is increased, the specific resistance of the filtercake also increases.

8. Comparison of Nahcolite with Sodium Bicarbonate - In general, the two additives reacted alike. The nahcolite proved to produce higher SO_2 conversion under similar conditions but the effect of particle size was the probable reason. A particle size analysis was not available for the sodium bicarbonate so no direct comparison could be made. The sodium bicarbonate had a high tendency to agglomorate prior to injection into the gas stream. Thus, it necessitated that rescreening the additive prior to feeding be carried out for all tests. The screen used was relatively coarse compared with its particle size of the sodium bicarbonate and undoubtedly further added to the difference in effective particle size of the additives.

   In the temperature range of 270-350°F percent of SO_2 conversion taking place in the gas stream was approximately 13% with both additives.

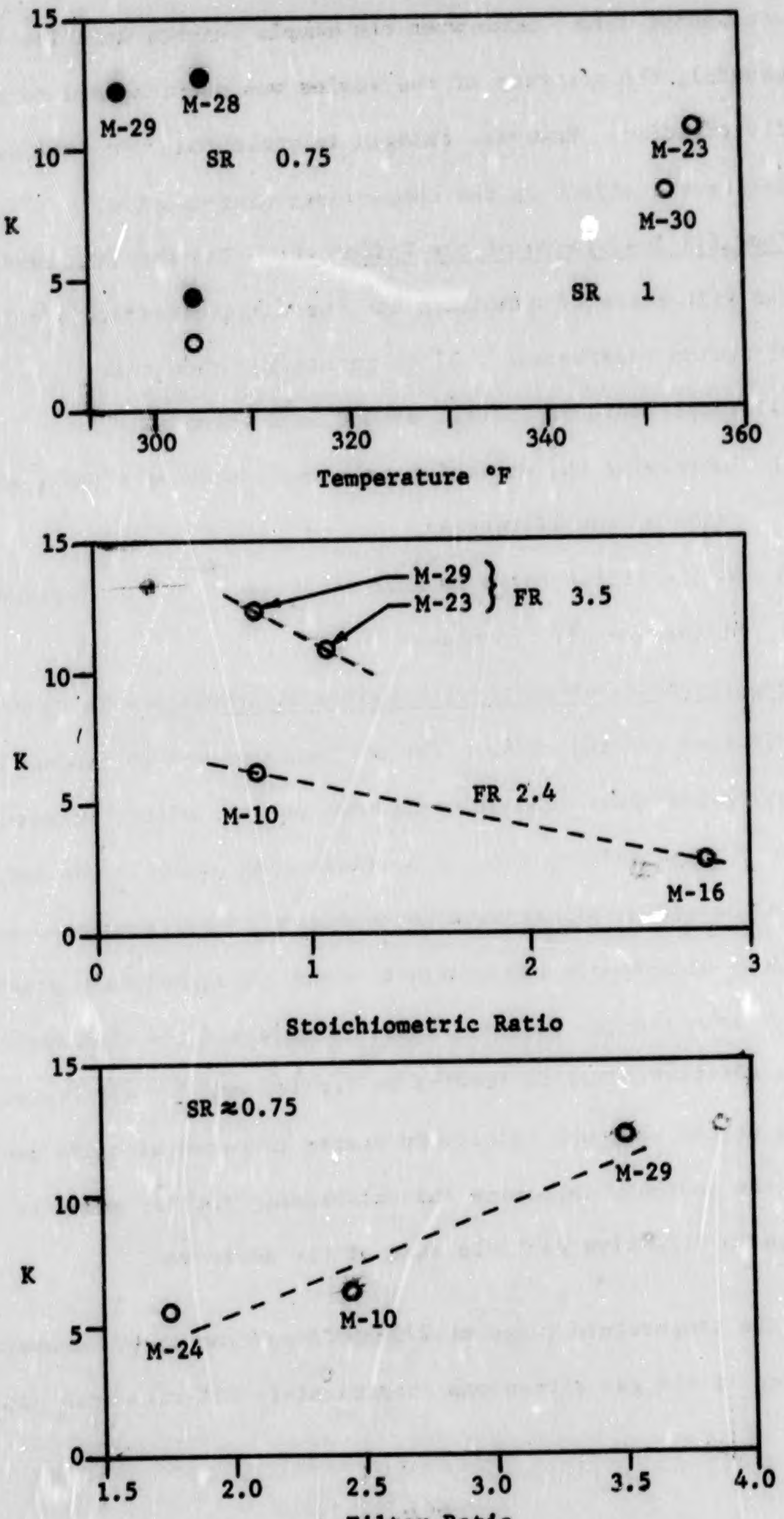


Fig. 20. Specific resistance of filter cake - Nahcolite

This increased to approximately 63% with both additives when the operating temperature range was 500-600°F.

There was a difference in total weight of additive required for the same stoichiometric rate. Nahcolite has a purity of 69.7% $NaHCO_3$ requiring approximately 43.5% more (by weight) nahcolite than sodium bicarbonate for the same stoichiometric rate. As the stoichiometric ratio is increased, the conversion efficiency and utilization effectiveness react similarly. Effects of other parameters for both additives are similar.

C) **Limes:**

Three (3) different lime additives were used in a series of tests for preliminary evaluation of their effectiveness in SO_2 conversion. The additive which showed the best conversion efficiency was then selected for more tests, namely, the hydrated dolomite.

The 3 additives were:

(i) Hydrated Dolomite, $Ca(OH)_2 \cdot MgO$

Composition (Typical)

Calcium oxide (CaO)	46.5 %
Magnesium oxide (MgO)	33.6 %
Silicon Dioxide (SiO_2)	0.15%
Aluminum oxide (Al_2O_3)	0.16%
Iron oxide (Fe_2O_3)	0.08%
Sulfur trioxide (SO_3)	0.15%
Combined water	18.5 %
Free Moisture	0.5 %

Screen Analysis (Typical)

Sieve	% Passing
30 Mesh	99.5%
200 Mesh	85.0%

Remarks: Packaging - Bulk and 50 lbs. paper bags. Bulk density 40-45 #/ft^3.

(ii) Hydrated Dolomite, Promoted

Hydrated dolomite -	99%
NaCl	1%

(iii) Chemical Hydrated Lime, $Ca(OH)_2$

Composition (Typical)

Total silica as SiO_2	0.32%
Total iron as Fe_2O_3	0.12%
Total aluminum as Al_2O_3	0.47%
Total calcium as $Ca(OH)_2$	97.58%
Total magnesium as $Mg(OH)_2$	0.63%
Total sulfur as SO_3	0.11%
Impurities	0.77%

__Sieve Analysis__

% passing 100 mesh screen	100.0
% passing 200 mesh screen	99.50
% passing 325 mesh screen	98.35

Remarks: This material meets American Water Works specification B 202-52T for chemical hydrated lime. Bulk density 35 #/ft^3.

A total of fifteen (15) tests were performed using the lime additives. Of these, eight (8) tests were performed using the hydrated dolomite to evaluate the effects of operating parameters. Table 6 summarizes the 15 test results using the 3 additives.

In general, unlike sodium bicarbonate and nahcolite, approximately 70-75% of the SO_2 conversion took place in suspension using limes as additives. The highest SO_2 conversion efficiency was 48.6% for dolomite at 640°F and stoichiometric ratio 3.

The limes also had a tendency to pile up on the upper tube sheets. (Refer to photo 12.) But it appeared not to yield any noticeable effects on the performance. In all the lime tests, the cyclic operation with continuous feed method was used. Therefore, this section includes no comparison on the mode of house operation and the specific resistance of the filtercake.

1. __Comparison of Lime Additives__ - The significant chemical reaction of the limes with SO_2 vapor at the test operating temperature ranges may be described as the following:

$$Ca(OH)_2 + SO_2 + 1/2\ O_2 \rightarrow CaSO_4 + H_2O$$

TABLE 6. SUMMARY - LIME TESTS

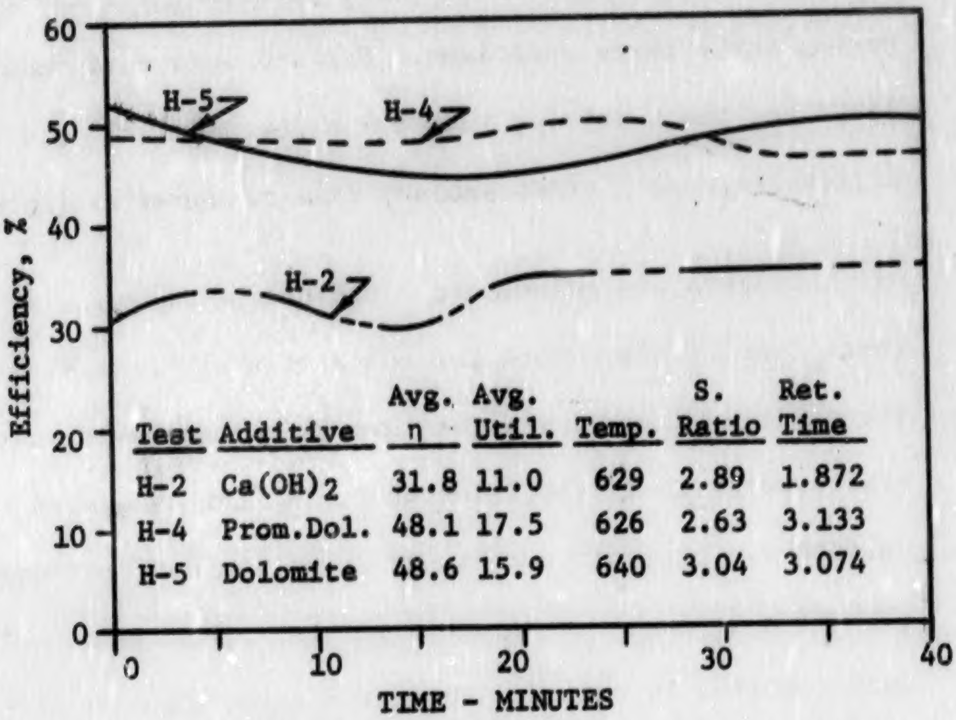
Test No.	Baghouse Oper.	Add-tive	Feed Method	Cycle Time Min.	Reten-tion Time Sec.	Gas Temp. In °F	Gas Temp. Out °F	Stoic Ratio	Total Flow Rate ACFM	House Avg. ΔP "H_2O	Add. Feed Rate #/Min	SO_2 In ppm	SO_2 Out ppm	SO_2 Conv. Eff.%	Add. Util. %	Conv. on Bags %
M-17	Cyclic	$Ca(OH)_2$	Cont.	40	2.740	350	295	2.610	10250	4.61	4.43	1303	1069	17.9	6.9	39.3
M-18	Cyclic	$Ca(OH)_2$	Cont.	80	2.740	350	296	3.440	10250	4.88	4.22	942	729	22.6	6.6	0
M-19	Cyclic	Dol.	Cont.	40	2.808	345	292	2.860	10000	4.31	8.60	1462	1197	18.1	6.3	32.3
M-20	Cyclic	Dol.	Cont.	80	2.808	352	298	2.490	10000	4.71	7.40	1456	1181	18.9	7.6	19.2
M-21	Cyclic	Dol.Pr.	Cont.	40	2.740	352	300	2.480	10250	4.79	6.54	1262	1021	19.1	7.7	33.6
M-22	Cyclic	Dol.Pr.	Cont.	80	2.773	356	301	2.660	10125	4.70	4.80	868	667	23.2	8.6	82.2
H-1	Cyclic	$Ca(OH)_2$	Cont.	40	2.726	585	437	3.000	10300	3.88	5.05	1657	1067	35.6	11.9	42.0
H-2	Cyclic	$Ca(OH)_2$	Cont.	40	1.872	629	513	2.890	15000	7.20	7.11	1734	1183	31.8	11.0	30.8
H-3	Cyclic	Dol.Pr.	Cont.	40												
H-4	Cyclic	Dol.Pr.	Cont.	40	3.133	626	530	2.630	15700	7.94	10.04	1600	832	48.1	18.33	21.5
H-5	Cyclic	Dol.	Cont.	40	3.074	640	537	3.040	16000	7.18	12.06	1643	846	48.6	15.9	32.0
H-6	Cyclic	Dol.	Cont.	40	2.674	589	438	2.810	10500	3.98	5.04	1085	732	32.5	11.6	21.0
H-7	Cyclic	Dol.	Cont.	80	4.555	599	435	2.690	10800	3.71	4.93	1087	626	42.4	15.8	14.1
H-14	Cyclic	Dol.	Cont.	40	4.641	586	495	0.902	10600	2.73	2.48	1634	1331	18.6	20.6	0
H-15	Cyclic	Dol.	Cont.	80	3.174	631	530	0.913	15500	4.90	3.81	1773	1384	21.9	24.0	12.3
H-16	Cyclic	Dol.	Cont.	40	3.153	629	525	0.781	15600	4.73	3.61	1704	1408	17.4	22.2	——

A total of eleven (11) tests were performed for the purpose of comparing these three additives. Six (6) were performed at approximately 350°F and the remaining five (5) at between 585° and 640°F. The efficiencies were plotted against time as shown in Figures 21 & 22.

All the operating parameters could not be identically maintained for these comparisons. Note the comparison of Tests H-2, H-4 & H-5 that the additive for H-2 was fed through the solenoid valves while the others were fed in the inlet duct. At the time when these tests were performed, difficulty was found in maintaining uniform additive distribution through the solenoid valves. The tests fed in the inlet duct resulted in extended retention time, thereby affecting the level of SO_2 conversion.

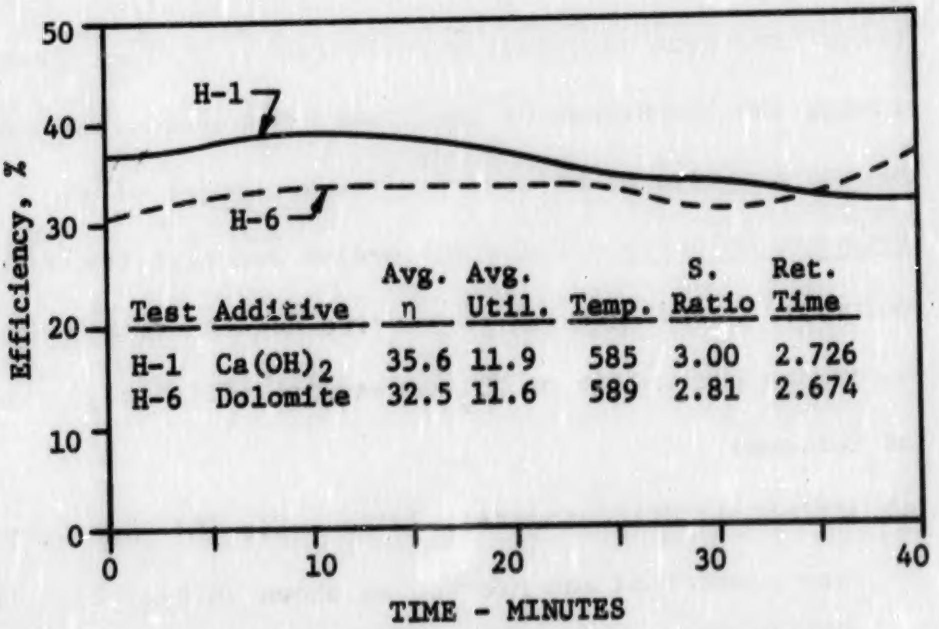
In general the variations in the SO_2 conversion efficiency and additive utilization were small. The difference in the test operating parameters, i.e.,stoichiometric ratio, feed point and temperature, could have been responsible for these variations, however small. Following the comparison of the limes, the hydrated dolomite was selected as the additive to be used for the remainder of the lime testing.

2. Hydrated Dolomite - Eight (8) medium and high temperature tests using dolomite as additive are considered here to examine the effects of the operating parameters on SO_2 conversion efficiency. They are outlined as follows:
   a) Effect of Stoichiometric Ratio - Six (6) high temperature tests are summarized and plotted as shown in Fig. 23. It can be seen that increasing the stoichiometric ratio will improve the conversion efficiency with a decrease in additive utilization efficiency.



Test	Additive	Avg. η	Avg. Util.	Temp.	S. Ratio	Ret. Time
H-2	$Ca(OH)_2$	31.8	11.0	629	2.89	1.872
H-4	Prom.Dol.	48.1	17.5	626	2.63	3.133
H-5	Dolomite	48.6	15.9	640	3.04	3.074

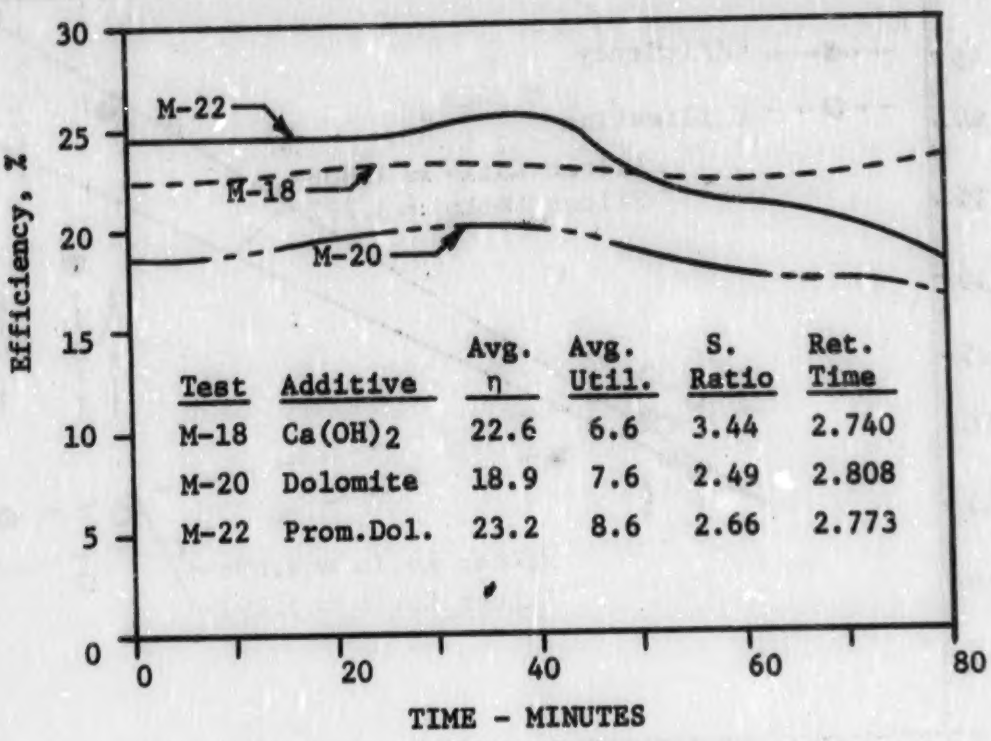
CYCLIC OPERATION - CONT. FEED - 15,000 CFM



Test	Additive	Avg. η	Avg. Util.	Temp.	S. Ratio	Ret. Time
H-1	$Ca(OH)_2$	35.6	11.9	585	3.00	2.726
H-6	Dolomite	32.5	11.6	589	2.81	2.674

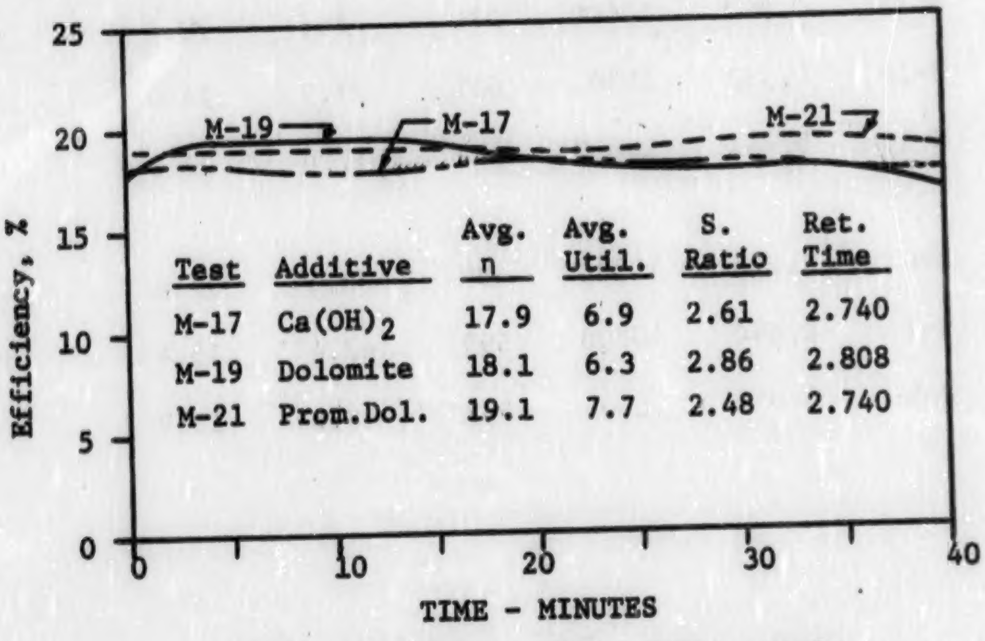
CYCLIC OPERATION - CONT. FEED - 10,000 CFM

FIG. 21. COMPARISON OF LIMES, I



Test	Additive	Avg. η	Avg. Util.	S. Ratio	Ret. Time
M-18	$Ca(OH)_2$	22.6	6.6	3.44	2.740
M-20	Dolomite	18.9	7.6	2.49	2.808
M-22	Prom.Dol.	23.2	8.6	2.66	2.773

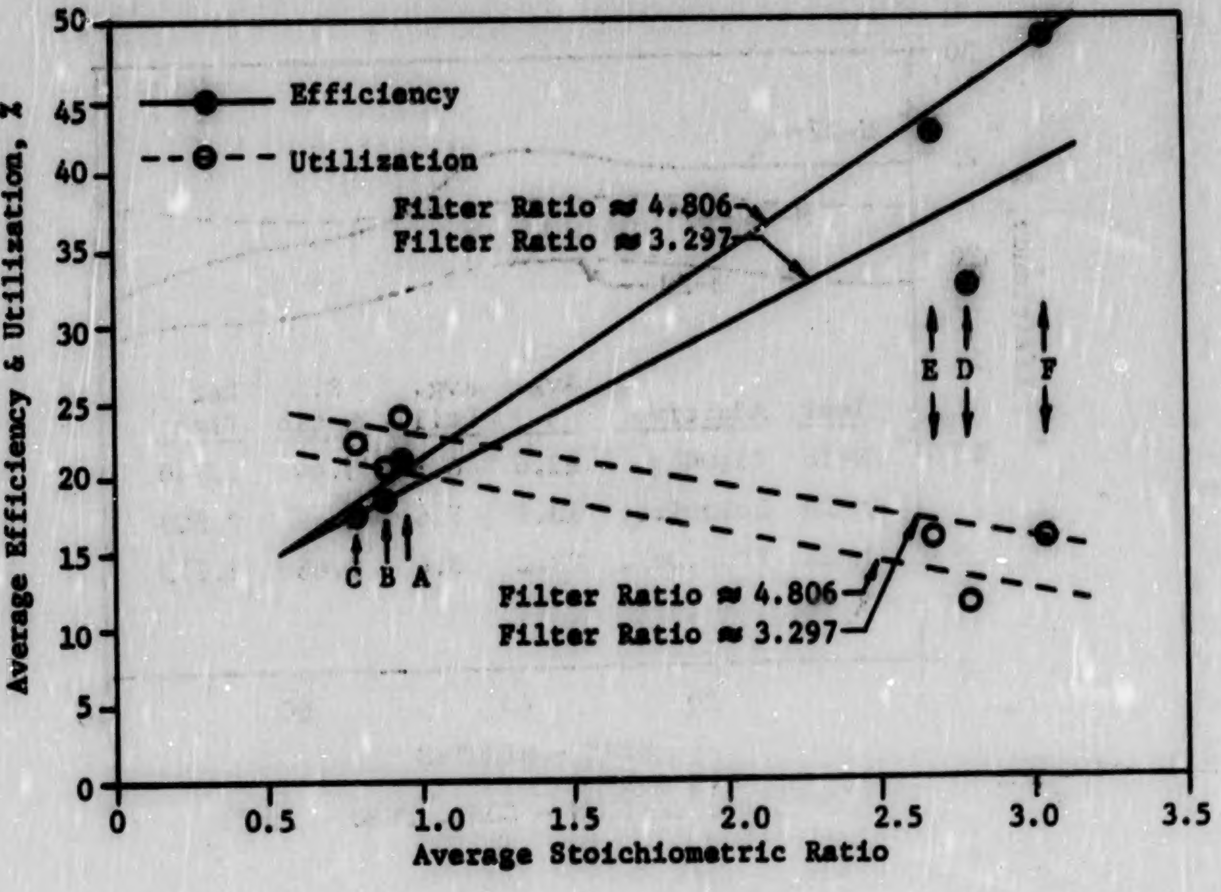
CYCLIC OPERATION - CONT. FEED - 350°F



Test	Additive	Avg. η	Avg. Util.	S. Ratio	Ret. Time
M-17	$Ca(OH)_2$	17.9	6.9	2.61	2.740
M-19	Dolomite	18.1	6.3	2.86	2.808
M-21	Prom.Dol.	19.1	7.7	2.48	2.740

CYCLIC OPERATION - CONT. FEED - 350°F

FIG. 22. COMPARISON OF LIMES, II



Point	Test No.	Stoich. Ratio	Flow ACFM	Temp. °F	% Eff.	% Util.	% Add. In Fallout
A	H-14	0.902	10600	586	18.6	20.6	13.1
B	H-15	0.913	1550	631	21.9	24.0	9.8
C	H-16	0.781	15000	629	17.4	22.2	16.7
D	H-6	2.810	10500	589	32.5	11.6	46.0
E	H-7	2.690	10800	599	42.4	15.8	39.1
F	H-5	3.040	16000	537	48.6	15.9	14.1

FIG. 23. EFFECT OF STOICHIOMETRIC RATIO, DOLOMITE

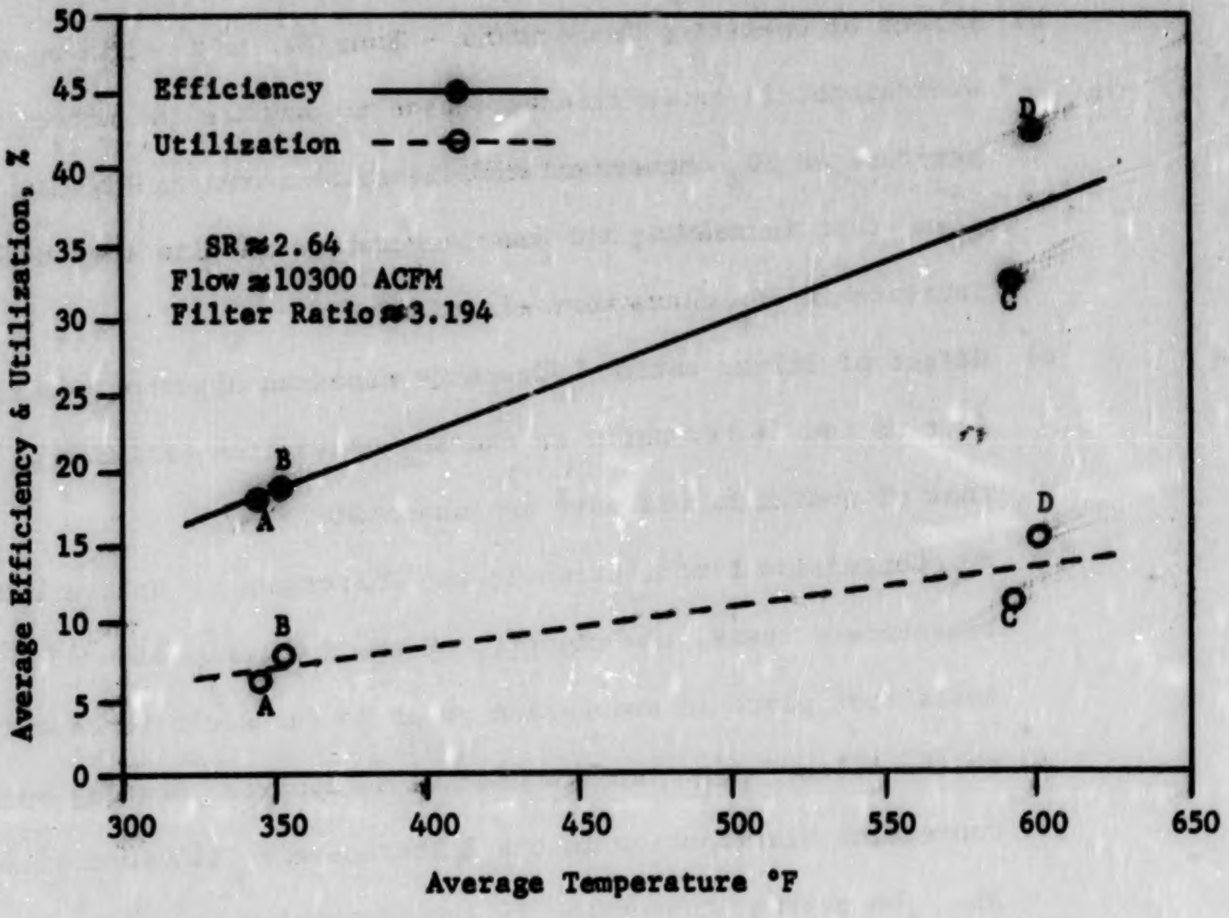
b) Effect of Operating Temperature - Four (4) tests with an average stoichiometric ratio 2.64 were used to compare the effect of temperature on SO_2 conversion efficiency as shown in Fig. 24. It is clear that increasing the gas temperature results in a definite increase in SO_2 conversion efficiency.

c) Effect of Filter Ratio - Figure 25 shows an apparent positive effect of the filter ratio on the SO_2 conversion efficiency, unlike that of sodium bicarbonate and nahcolite.

d) SO_2 Conversion Distribution in the Filterhouse - Unlike sodium bicarbonate tests, the majority of the SO_2 conversion of dolomite tests took place in suspension prior to the additive depositing on the filter bags. Temperature has no apparent bearing on the conversion distribution in the filterhouse as illustrated in Fig. 26. The average conversion in suspension for these tests is about 80%.

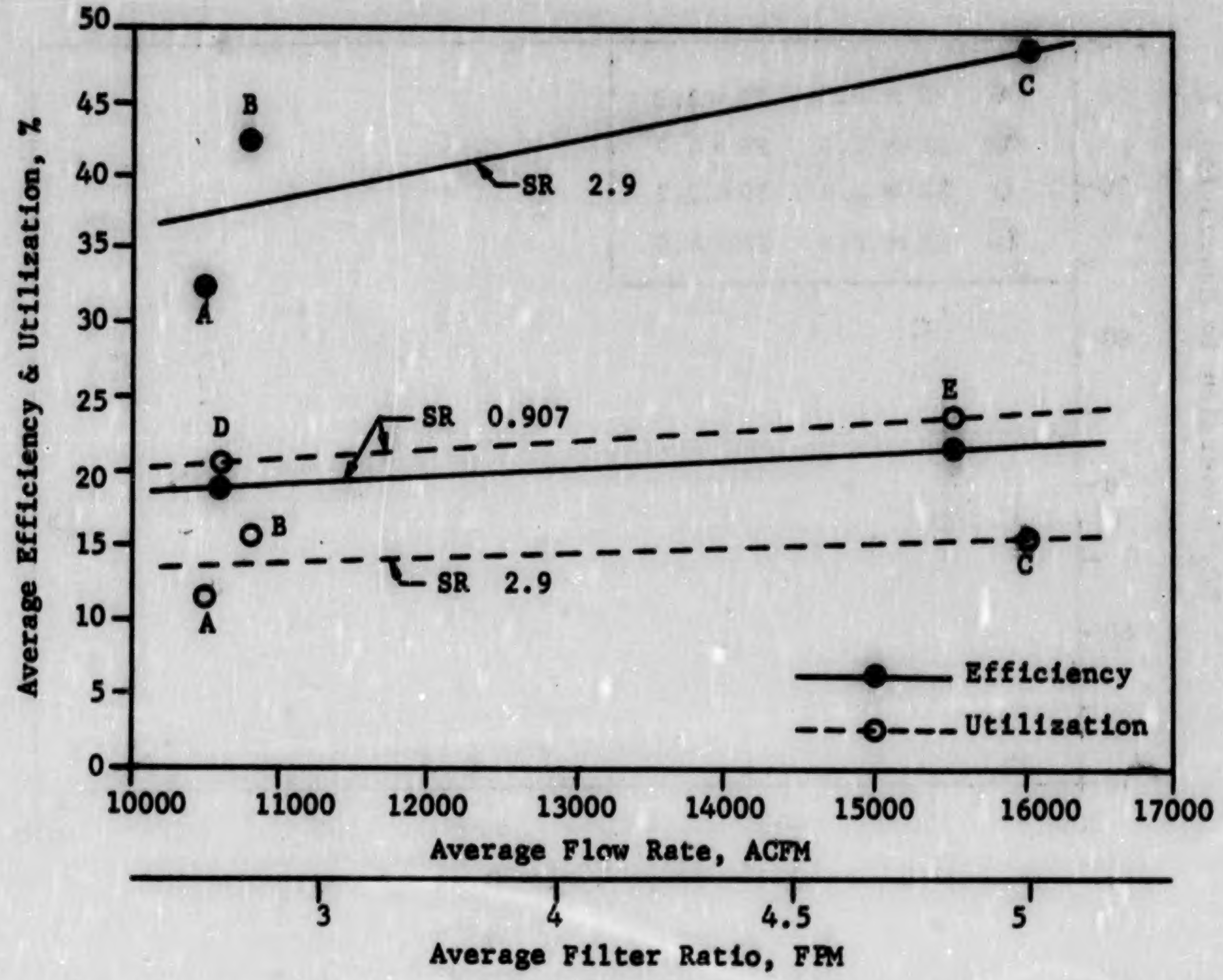
e) Compartment Distribution - The distribution pattern of fallout and shakedown are shown in Table 7. In general, there were higher fallout and shakedown weights in compartments with higher flow rates. The stoichiometric rates had no apparent effect on compartment distribution. The poor distribution in Test M 21 was caused by plugging of the additive valve in compartment "B".

Unsatisfactory correlation in some cases between fallout and shakedown distribution may have been caused by the deflation system for each compartment. This amount is not known, i.e., 40% of the total may go out the deflation system in compartment "A" while only 10% with compartment "C". In general, the correlation between fallout and shakedown samples was satisfactory.



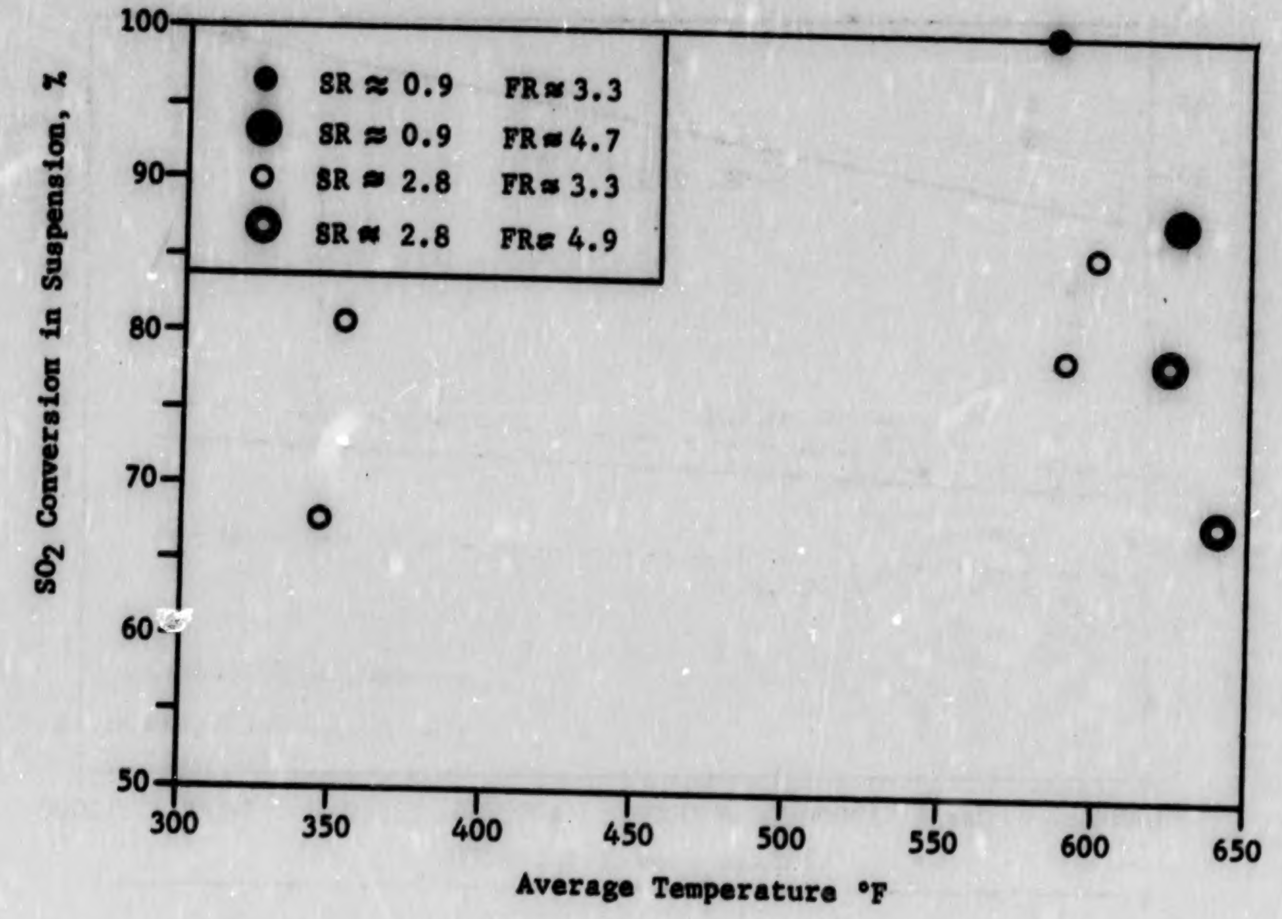
Point	Test No.	Temp. °F	Stoich. Ratio	Flow ACFM	Efficiency %	Utilization %
A	M-19	345	2.86	10,000	18.1	6.3
B	M-20	352	2.18	10,000	18.8	7.6
C	H-6	589	2.81	10,500	32.5	11.6
D	H-7	599	2.69	10,800	42.4	15.8

Fig. 24. Effect of Temperature - Dolomite



Point	Test No.	Flow ACFM	Filter Ratio	Temp. °F	Stoich. Ratio	%	Util. %
A	H-6	10500	3.256	589	2.81	32.5	11.6
B	H-7	10800	3.349	599	2.69	42.4	15.8
C	H-5	16000	4.961	640	3.04	48.6	15.9
D	H-14	10600	3.287	586	0.902	18.6	20.6
E	H-15	15500	4.806	631	0.913	21.9	24.0

FIG. 25. EFFECT OF FILTER RATIO, DOLOMITE



Test No.	Flow ACFM	Filter Ratio	Stoich. Ratio	Temp. °F	House Operation	Type Feed	% SO_2 Conv. in Gas
M-19	10000	3.101	2.860	345	Cyclic	Continuous	67.7
M-20	10250	3.178	2.480	352	Cyclic	Continuous	80.8
H-4	15700	4.868	2.630	626	Cyclic	Continuous	78.5
H-5	16000	4.961	3.040	640	Cyclic	Continuous	68.0
H-6	10500	3.256	2.810	589	Cyclic	Continuous	79.0
H-7	10800	3.349	2.690	599	Cyclic	Continuous	85.9
H-14	10600	3.287	0.902	586	Cyclic	Continuous	100.0
H-15	15500	4.806	0.913	631	Cyclic	Continuous	87.7

FIG. 26. SO_2 CONVERSION IN SUSPENSION, DOLOMITE

TABLE 7. COMPARTMENT DISTRIBUTION OF ADDITIVE AND ASH SAMPLES

	Compartment Fallout (%)				Compartment Shakedown (%)			
Test No.	A	B	C	D	A	B	C	D
M-17	24.7	21.4	25.3	28.6	14.0	23.8	32.5	29.7
M-18	21.9	24.7	32.0	21.3	20.6	28.4	23.4	27.6
M-19	21.5	22.3	33.9	22.3	17.2	20.0	21.4	31.4
M-20	13.2	24.5	38.4	23.9	16.9	15.1	34.9	33.1
M-21	27.4	08.4	39.5	24.7	25.1	05.9	42.4	26.5
M-22	33.3	21.7	22.5	22.5	26.3	17.4	23.2	33.1
H-1	26.7	18.6	25.6	29.1	26.5	19.2	22.0	32.3
H-2	16.8	22.4	32.7	28.1	13.3	39.2	25.3	22.2
H-4	22.1	26.2	32.8	18.9	19.7	24.9	30.5	24.9
H-5	24.6	23.2	31.9	20.3	26.2	19.8	31.6	22.4
H-6	14.3	12.5	31.3	41.9	15.7	23.5	34.3	26.5
H-7	16.2	22.2	14.1	47.5	19.7	19.7	25.2	35.4
H-14	33.3	31.5	16.7	18,5	20.0	28.0	28.0	24.0
H-15	06/6	07.7	54.9	30.8	18.5	29.4	25.1	27.0
H-16	25.0	20.8	36.1	18.1	22.1	12.6	31.6	33.7
Average	21.9	20.6	31.2	26.3	20.1	21.8	29.4	28.7

APPENDIX A

Measurement of NO_2 of the Flue Gas:

In the first phase of testing it was observed that when sodium bicarbonate was added to the flue gas, the resulting outlet gas was light yellow in color. As the feeding stopped, the stack gas quickly cleared. Later when using nahcolite as an additive the same effect resulted. But when using the lime additives, no coloring of the outlet stack gas occurred. It was felt at the time that the concentration level of NO_2 might be the cause of the coloring of the outlet gas. Therefore, Public Service of New Jersey initiated, with the approval of APCo and NAPCA, a program to measure the nitrogen oxides in the gas stream. The Chemical Division of Public Service have conducted a number of measurements of NO_2 levels of the inlet and outlet gases of the filterhouse during the testing period under various operating conditions with different additives. It was found that no obvious conclusions could be derived from the measurement as to why the color existed only with the present of $NaHCO_3$. The measurements and its conditions are presented here for information only.

Table No. 8

Summary Measurement of NO_2

	Oxides of Nitrogen, ppm		% Diff.	Inlet		Stack	SO_2 ppm		% Diff.	
Test No.	Inlet	Outlet	NO_2	Duct	Manifold	Disch.	Inlet	Outlet	SO_2	Additive
M-10	828	723	-12.7	352	330	305	905	300	-68.4	Nahcolite
M-11	848	614	-27.6	353	330	295	1050	100	-90.5	Nahcolite
M-14	914	529	-42.1	352	330	290	1070	290	-72.9	Nahcolite
M-17	1019	826	-18.9	350	330	295	1450	1050	-27.6	Ca $(OH)_2$
M-18	787	918	+16.6	350	330	300	925	725	-21.6	Ca $(OH)_2$
M-23	924	871	- 5.7	355	340	320	675	200	-70.4	Nahcolite
M-24	884	780	-11.8	352	330	290	850	150	-82.4	Nahcolite
M-25	683	687	+ 0.6	349	325	275	675	325	-51.9	Na HCO_3
M-26	1031	924	-10.4	356	330	300	1200	475	-60.4	Na HCO_3
M-27	1162	993	-14.5	355	330	300	1375	725	-47.3	Na HCO_3
M-28	933	885	- 5.1	305	295	280	1150	575	-50.0	Nahcolite
M-30	849	611	-28.0	352	345	315	840	290	-65.5	Nahcolite
M-31	853	796	- 6.7	352	340	300	950	125	-86.8	Na HCO_3
M-32	808	798	- 1.2	350	325	300	1025	125	-87.8	Na HCO_3
*	1048	1139	+ 8.7	620	590	480	1650	1075	-34.8	Dolomite
*	1153	1056	- 8.4	620	590	480	1500	1000	-33.3	Dolomite

*Experimental runs at high temperature

REMARKS: Inlet duct manifold, stack discharge temperatures, and SO_2 readings were taken at the Air Preheater Co. trailer.

APPENDIX B

Sample Calculation for SO_2 Conversion Distribution:

The major purpose of this testing program was to evaluate the filterhouse as a chemical contactor. For this evaluation, it is necessary to determine where the major part of the chemical reaction (SO_2 conversion) takes place, i.e., in the gas stream or as the flue gas passes through the filtercake on the bags.

The formulae for the chemical reaction are;

a) Using sodium bicarbonate or nahcolite

$2NaHCO_3 + SO_2 + 1/2\ O_2 \rightarrow Na_2SO_4 + 2CO_2 + H_2O$

b) Using dolomitic lime

$Ca(OH)_2 \cdot MgO + SO_2 + 1/2\ O_2 \rightarrow CaSO4 + H_2O$

Step 1. The value of SO_2 is calculated based on the differential readings between the inlet and outlet gas levels of SO_2 in ppm. These are recorded on the Intertech SO_2 monitor recorder. The formula used is;

$$\#SO_2 = \frac{(Q)(T_s)(\Delta c)(M)(t)}{(T_T)(b)}$$

where;

Q = Flue Gas flow rate, ACFM
T_s = Standard temperature = 520 °R
Δc = SO_2 concentration differential across the filterhouse, ppm
M = Molecular weight of SO_2 = 64
t = Total test period - minutes
T_T = Flue gas inlet temperature - °R
b = Standard Lb. molar volume = 379

Step 2. The change in measurable weight between the inlet and outlet of the filterhouse is then calculated. This change is;

a) For sodium bicarbonate $+ SO_2 + 1/2\ O_2 - 2CO_2 - H_2O$

b) For dolomitic lime $+ SO_2 + 1/2\ O_2 - H_2O$

This change can be defined in terms of SO_2 by the use of the molecular weights of these substances. For (a) above, the term is - 0.406 (SO_2); and for (b) above, the term is + 0.969 (SO_2).

The total weight of the input materials for any test can now be calculated and are;

a) For sodium bicarbonate	# Additive + # Flyash - 0.406(#SO_2)
b) For dolomitic lime	# Additive + # Flyash + 0.969(#SO_2)

Step 3. A chemical analysis on the test samples of fallout, shakedown and deflation for some of the tests was performed by NAPCA in Cincinnati. The results (shown on the following individual data sheets) include;

a) Percent sodium or calcium

b) Percent SO_3; and

c) Percent SO_4.

By multiplying the percent Na or Ca by the sample weights (fallout, shakedown and deflation), the distribution of the input additive and flyash results.

Step 4. For this analysis, the item of interest is the actual conversion (SO_2) taking place during the tests. Tests performed on unused additives and flyash indicate that they included small percentages of SO_3 and SO_4. Since these would affect the analysis, they must be removed from the total SO_3 and SO_4 in the test sample. For an example, assume the following information is known.

	Weight #	% SO_4	# SO_4
Additive	75	3.12	0.2325
Flyash	25	0.79	0.1975
Total Sample	100	3.12	3.1200

The actual SO_4 resulting from the reaction taking place during the test is then 3.1200 - 0.2325 - 0.1975 = 2.6900 #SO_4.

Using the above procedure, the weight of SO_3 and SO_4 resulting from the test are calculated for the (a) fallout, (b) shakedown, and (c) deflation samples.

Step 5. These weights of SO_3 and SO_4 are then converted to SO_2. They are multiplied by the ratio of the molecular weights. The factors are 0.800 for SO_3 and 0.667 for SO_4. Totalling these figures results in (a) #SO_2 converted in the fallout and (b) #SO_2 total--converted during the test.

Step 6. For the analysis, the following assumptions are made.

a) No chemical reaction takes place in the hopper. And,

b) The sulfur content in the shakedown and deflation samples was the same as that in the fallout prior to deposit on the filterbags.

The percent of the total additive that was fallout is calculated by dividing (the weight of the additive in the fallout) by (the weight of the additive input plus the weight change in terms of SO_2).

The SO_2 conversion taking place in the gas stream is then calculated by using the formula;

$$\#SO_2 \text{ converted in gas stream} = \frac{\#\ SO_2 \text{ Converted in Fallout } (100)}{\% \text{ of Total Additive in Fallout}}$$

This figure is then divided by the total SO_2 converted and the resulting figure is the percent of SO_2 conversion taking place in the gas stream.

Following is a typical calculation using test M-3 for illustration.

1. Calculate # SO_2

$$\#\ SO_2 = \frac{(Q)(T_s)(\Delta c)(M)(t)}{(T_T)(b)} = \frac{10300(520)(526)(64)(40)}{809(379)(1 \times 10^{-6})} = 23.52\ \#SO_2$$

2. The change in measurable weight = -0.406 (#SO_2) = -0.406 (23.52) = -9.5#. The total weight of input materials = 109# additive + 69# ash - 9.5# change = 168.5#.

3. Performing step #3 results in the following table.

Sample	Pounds	Percent Sodium	Pounds Additive	Corrected Pounds Additive	# Ash
Fallout	70.0	70.0	49.0	59.5	10.5
Shakedown	30.5	35.5	10.8	13.0	17.5
Deflation	68.0	32.3	22.0	27.0	41.0
TOTAL -	108.5	----	81.8	99.5	69.0

4. The weights of SO_3 and SO4 are then calculated. The results are;

	SO_3						SO_4				
Sample:	#In Sample	-	#In Ash	=	#Total		#In Sample	-	#In Ash	=	#Total
Fallout	0.3290	-	0.0556	=	0.2734		2.5270	-	0.0829	=	2.4441
Shakedown	0.2623	-	0.0928	=	0.1695		5.3588	-	0.1382	=	5.2206
Deflation	0.5100	-	0.2173	=	0.2927		10.3700	-	0.3239	=	10.0461
TOTAL -					0.7356						17.7108

NOTE: There were no SO_3 or SO_4 in the sodium bicarbonate additive so no correction had to be made for same.

5. Converting the SO_3 and SO_4 to SO_2, we have;

In fallout 0.2734 #SO_3(0.800) = 0.2187 #SO_2
& 2.4441 #SO_4(0.667) = 1.6302 #SO_2

Total SO_2 in Fallout = 1.8489 #

Total 0.7356 #SO_3(0.800) = 0.5885 #SO_2
& 17.7108 #SO_4(0.667) = 11.8131 #SO_2

Total SO_2 Converted = 12.4016 #

6. $\frac{\text{Additive in Fallout} = 59.5\#}{\text{Total Additive} = 99.5\#}$ = 59.8% of Total Additive in Fallout.

SO_2 converted in Gas Stream = $\frac{1.8489(100)}{59.8}$ = 3.0918 #SO_2

$\frac{3.0918\ \#SO_2\ \text{Converted in Gas}}{12.4014\ \#SO_2\ \text{Converted Total}} = \underline{24.93\%}$ of total conversion taking place in gas stream.

APPENDIX C

Table 9 - Lb. SO_2 Removed, Instrument Vs. Chemical*

Test No.	Lb. SO_2 Removed	
	Instrument	Chemical
	SODIUM BICARBONATE	
L-1	11.77	-----
L-2	50.85	-----
L-3	93.68	55.08
L-4	27.95	17.28
L-5	20.08	-----
L-6	29.82	-----
L-7	30.05	-----
L-8	76.33	-----
L-9	51.96	-----
L-9A	52.92	-----
L-10	142.64	-----
L-11	63.03	-----
L-12	59.97	64.70
L-13	81.38	-----
L-14	45.83	-----
M-1	30.19	-----
M-2	36.16	-----
M-3	21.55	23.52
M-4	38.55	35.31
M-5	105.65	-----
M-6	177.16	182.54
M-7	46.98	47.48
M-8	41.30	-----
M-25	24.17	-----
M-26	48.72	-----
M-27	24.17	-----
M-31	52.83	-----
M-32	59.67	-----
H-8	66.00	51.54
H-9	70.69	54.78
H-10	56.83	51.13
H-13	72.73	33.63

Test No.	Lb. SO_2 Removed	
	Instrument	Chemical
	NAHCOLITE	
M-9	24.80	-----
M-10	41.83	-----
M-11	43.71	-----
M-12	27.36	17.30
M-13	40.86	22.80
M-14	54.44	57.18
M-15	33.57	29.37
M-16	54.16	50.50
M-23	38.10	21.27
M-24	32.62	16.98
M-28	27.78	16.69
M-29	24.22	13.59
M-30	39.27	41.17
H-11	65.76	46.75
H-12	86.69	52.16
	LIMES	
M-17	10.40	8.09
M-18	18.93	17.95
M-19	13.20	9.16
M-20	27.13	14.18
M-21	12.19	6.32
M-22	19.97	49.14
H-1	20.07	9.61
H-2	26.66	15.81
H-3	-----	-----
H-4	29.00	25.31
H-5	40.72	29.89
H-6	12.41	6.99
H-7	31.59	15.91
H-14	11.29	6.86
H-15	36.32	20.29
H-16	14.32	

*Instrument - Based on the SO_2 monitor strip charts
Chemical - Based on chemical analysis of collected samples }Refer Appendix B

TEST NO.	L-1	FLOW (ACFM)	10125	TEMP (°F)	286
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.952
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	24.8	UTILIZATION (%)	25.7
CYCLE TIME	ON 30 OFF 10	DATE	29 April 69	OVERALL TIME	1214-1415

TEMPERATURES (°F)

Inlet Duct	286	Manifold	271
Upper Fabric	264	Lower Fabric	251
Outlet Duct	242		

FLOWS (ACFM)

Total House	10125	Deflation	3250
Comp. "A"	3400	Comp. "C"	3600
Comp. "B"	3250	Comp. "D"	4050

SO_2 LEVELS (PPM)

Inlet -	From	880	To	1200	Avg	995.5
Outlet -	From	560	To	920	Avg	748.5

Average Efficiency 24.8 %

PRESSURE DROPS "H_2O

House -	From	4.5	To	5.5	Avg	4.99
Comp. "A" -	From	3.25	To	4.00	Avg	3.59
Comp. "B" -	From	3.15	To	4.70	Avg	4.13
Comp. "C" -	From	3.40	To	4.55	Avg	3.93
Comp. "D" -	From	3.05	To	4.45	Avg	3.87

ADDITIVE

Feed Location Inlet Manifold

Rate 2.96 #/Min. Total 240# For 81 Min.

FLYASH

Corrected Inlet Grain Loading 1.27 Grains/Ft^3

Total For Test Period 74.0#

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	8	8.9	68.2	31.8		
	Comp. "B"	32	35.6	42.8	57.2		
	Comp. "C"	30	33.3	49.3	50.7		
	Comp. "D"	20	22.2	50.6	49.4		
	Total	90	100.0		51.0	Not Available	
SHAKEDOWN -	Comp. "A"	4	9.0	53.5	46.5		
	Comp. "B"	17.5	39.3	28.9	71.1		
	Comp. "C"	10.5	23.6	23.5	76.5		
	Comp. "D"	12.5	28.1	24.1	75.9		
	Total	44.5	100.0		71.51	Not Available	
DEFLATION - TOTAL				52.1	47.9	Not Available	

REMARKS

TEST NO.	L-2	FLOW (ACFM)	10200	TEMP (°F)	292
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.739
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	39.1	UTILIZATION (%)	52.29
CYCLE TIME	ON 60 OFF 20	DATE	29 April 69	OVERALL TIME	1429-1831

TEMPERATURES (°F)	Inlet Duct	292	Manifold	276
	Upper Fabric	272	Lower Fabric	258
	Outlet Duct	256		

FLOWS (ACFM)	Total House	10200	Deflation	3400
	Comp. "A"	3400	Comp. "C"	3500
	Comp. "B"	3175	Comp. "D"	3950

SO_2 LEVELS (PPM)	Inlet	From	1140	To	1560	Avg	1366.4
	Outlet	From	560	To	1060	Avg	832.7

Average Efficiency 39.1 %

PRESSURE DROPS "H_2O	House	From	4.45	To	6.00	Avg	5.24
	Comp. "A"	From	3.30	To	4.70	Avg	4.02
	Comp. "B"	From	3.65	To	5.25	Avg	4.51
	Comp. "C"	From	3.00	To	5.10	Avg	4.15
	Comp. "D"	From	5.25	To	4.85	Avg	4.13

ADDITIVE

Feed Location Inlet Manifold

Rate 3.15 #/Min. Total 510 # For 162 Min.

FLYASH

Corrected Inlet Grain Loading 1.27 Grains/Ft^3

Total For Test Period 147.9 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	11	6.5	42.3	57.7		
	Comp. "B"	42	25.0	10.4	89.6		
	Comp. "C"	65	38.7	11.2	88.8		
	Comp. "D"	50	29.8	9.8	90.2		
	Total	168	100.0		87.4	Not Available	
SHAKEDOWN -	Comp. "A"	11	15.2	60.4	39.6		
	Comp. "B"	19.5	26.9	38.0	62.0		
	Comp. "C"	20.5	28.3	33.4	66.6		
	Comp. "D"	21.5	29.6	29.1	70.9		
	Total	72.5	100.0		62.5	Not Available	
DEFLATION - TOTAL				41.3	58.7	Not Available	

REMARKS

TEST NO.	L-3	FLOW (ACFM)	10125	TEMP (°F)	350
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.94
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	53.3	UTILIZATION (%)	52.38
CYCLE TIME	ON 90 OFF 30	DATE	8 May 69	OVERALL TIME	0910-1350

TEMPERATURES (°F)

Inlet Duct	350	Manifold	333
Upper Fabric	324	Lower Fabric	308
Outlet Duct	300		

FLOWS (ACFM)

Total House	10125	Deflation	3600
Comp. "A"	3150	Comp. "C"	3100
Comp. "B"	2900	Comp. "D"	3300

SO_2 LEVELS (PPM)

	From	To	Avg
Inlet	1090	1400	1335.2
Outlet	420	780	624.0

Average Efficiency 53.3 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	5.45	7.50	6.57
Comp. "A"	4.40	6.00	5.30
Comp. "B"	4.55	6.75	5.70
Comp. "C"	3.90	6.70	5.50
Comp. "D"	4.05	6.45	5.48

ADDITIVE Feed Location Solenoid Valves

Rate 3.79 #/Min. Total 455 # For 120 Min.

FLYASH Corrected Inlet Grain Loading 1.81 Grains/Ft^3

Total For Test Period 204.4 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	23	10.0	37.3	62.7	0.5[illegible]	4.12
	Comp. "B"	37	16.1	29.9	70.1		
	Comp. "C"	40	17.4	34.9	65.1	0.70	4.35
	Comp. "D"	130	56.5	14.7	85.3		
	Total	230	100.0		77.1	0.66	4.30
SHAKEDOWN -	Comp. "A"	35	20.6	65.6	34.4		
	Comp. "B"	43.5	25.7	57.7	42.3		
	Comp. "C"	38.5	22.7	61.4	38.6		
	Comp. "D"	52.5	31.0	39.1	60.9		
	Total	169.5	100.0		45.6	1.03	19.77
DEFLATION - TOTAL					*	0.85	16.29

REMARKS *

Comp. A	26.4%
Comp. B	35.0%
Comp. C	30.2%
Comp. D	48.4%

TEST NO.	L-4	FLOW (ACFM)	9800	TEMP (°F)	272
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.978
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	52.0	UTILIZATION (%)	18.2
CYCLE TIME	ON 30 OFF 10	DATE	2 May '69	OVERALL TIME	0846-1050

TEMPERATURES (°F)	Inlet Duct	272	Manifold	262
	Upper Fabric	258	Lower Fabric	250
	Outlet Duct	248		

FLOWS (ACFM)	Total House	9800	Deflation	3200
	Comp. "A"	3100	Comp. "C"	3600
	Comp. "B"	3175	Comp. "D"	3925

SO_2 LEVELS (PPM)	Inlet - From	1000	To	1320	Avg	1143.2
	Outlet - From	400	To	720	Avg	548.6

Average Efficiency 52 %

PRESSURE DROPS "H_2O	House - From	4.55	To	5.40	Avg	4.99
	Comp. "A" - From	3.25	To	4.35	Avg	3.81
	Comp. "B" - From	3.95	To	4.65	Avg	4.30
	Comp. "C" - From	3.30	To	4.30	Avg	3.81
	Comp. "D" - From	3.30	To	4.35	Avg	3.87

ADDITIVE Feed Location Solenoid Valves

Rate 10.49 #/Min. Total 430 # For 41 Min.

FLYASH Corrected Inlet Grain Loading 1.28 Grains/Ft^3

Total For Test Period 73.3 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	63	24.8	5.1	94.9		
	Comp. "B"	82	32.3	5.6	94.4		
	Comp. "C"	57	22.4	7.2	92.8		
	Comp. "D"	52	20.5	7.5	92.5		
	Total	254	100.0		93.8	0.34	0.31
SHAKEDOWN -	Comp. "A"	15	25.6	33.7	66.3		
	Comp. "B"	17	29.1	28.9	71.1		
	Comp. "C"	10	17.1	26.9	73.1		
	Comp. "D"	16.5	28.2	23.6	76.4		
	Total	58.5	100.0		71.7	0.32	13.08
DEFLATION - TOTAL					---	0.43	9.12

REMARKS

TEST NO.	L-5	FLOW (ACFM)	10000	TEMP (°F)	284
OPERATION	Cyclic	TYPE FEED	Batch	STOICH. RATIO	0.976
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	40.4	UTILIZATION (%)	42.0
CYCLE TIME	ON 30 OFF 10	DATE	2 May '69	OVERALL TIME	1708-1858

TEMPERATURES (°F)				
	Inlet Duct	284	Manifold	265
	Upper Fabric	261	Lower Fabric	252
	Outlet Duct	250		

FLOWS (ACFM)				
	Total House	10000	Deflation	3350
	Comp. "A"	2950	Comp. "C"	3450
	Comp. "B"	3150	Comp. "D"	3650

SO_2 LEVELS (PPM)							
	Inlet	From	960	To	1180	Avg	1052.7
	Outlet	From	500	To	760	Avg	627.3

Average Efficiency 40.4 %

PRESSURE DROPS "H_2O							
	House	From	4.70	To	5.50	Avg	5.09
	Comp. "A"	From	*	To	*	Avg	*
	Comp. "B"	From	4.15	To	4.80	Avg	4.48
	Comp. "C"	From	3.80	To	4.60	Avg	4.17
	Comp. "D"	From	3.60	To	4.60	Avg	4.13

ADDITIVE

Feed Location Solenoid Valves

Rate 31.82 #/Min. Total 350 # For 11 Min.

FLYASH

Corrected Inlet Grain Loading 1.28 Grains/Ft^3

Total For Test Period 73.3 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	27	31.4	11.6	88.4		
	Comp. "B"	14	16.3	21.8	78.2		
	Comp. "C"	23	26.7	32.8	67.2		
	Comp. "D"	22	25.6	10.2	89.8		
	Total	86	100.0		81.43	Not Available	
SHAKEDOWN -	Comp. "A"	9.5	30.2	42.3	57.7		
	Comp. "B"	7.0	22.2	51.1	48.9		
	Comp. "C"	7.5	23.8	45.4	54.6		
	Comp. "D"	7.5	23.8	45.6	54.4		
	Total	31.5	100.0		54.2	0.40	17.61
DEFLATION - TOTAL				45.2	54.8	0.70	16.16

REMARKS *"A" compartment pressure drops not available due to transmitter difficulties.

TEST NO.	L-6	FLOW (ACFM)	9900	TEMP (°F)	275
OPERATION	Cyclic	TYPE FEED	Batch	STOICH. RATIO	3.425
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	61.3	UTILIZATION (%)	17.9
CYCLE TIME	ON 30 OFF 10	DATE	2 May '69	OVERALL TIME	1434-1614

TEMPERATURES (°F)	Inlet Duct	275	Manifold	263
	Upper Fabric	260	Lower Fabric	252
	Outlet Duct	248		

FLOWS (ACFM)	Total House	9900	Deflation	3200
	Comp. "A"	3150	Comp. "C"	3450
	Comp. "B"	3200	Comp. "D"	3500

SO_2 LEVELS (PPM)	Inlet -	From	920	To	1150	Avg	1026.7
	Outlet -	From	260	To	560	Avg	397.4

Average Efficiency 61.3 %

PRESSURE DROPS "H_2O	House -	From	4.50	To	5.40	Avg	4.94
	Comp. "A" -	From	3.30	To	4.35	Avg	3.89
	Comp. "B" -	From	3.65	To	4.60	Avg	3.99
	Comp. "C" -	From	3.60	To	4.60	Avg	4.07
	Comp. "D" -	From	3.35	To	4.55	Avg	4.02

ADDITIVE Feed Location Solenoid Valves

Rate 43.6 #/Min. Total 436 # For 10.0 Min.

FLYASH Corrected Inlet Grain Loading 1.30 Grains/Ft^3

Total For Test Period 74.4 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	140	28.2	7.6	92.4		
	Comp. "B"	107	21.6	18.8	81.2		
	Comp. "C"	87	17.5	32.0	68.0		
	Comp. "D"	162	32.7	32.0	68.0		
	Total	496	100.0		77.7	Not Available	
SHAKEDOWN -	Comp. "A"	20	31.3	30.2	69.8		
	Comp. "B"	13	20.3	14.8	85.2		
	Comp. "C"	15.5	24.2	32.9	67.1		
	Comp. "D"	15.5	24.2	30.1	69.9		
	Total	64	100.0		72.3	0.47	14.36
DEFLATION - TOTAL				30.0	70.0	0.44	13.22

REMARKS

TEST NO.	L-7	FLOW (ACFM)	10100	TEMP (°F)	282
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.220
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	29.6	UTILIZATION (%)	22.8
CYCLE TIME	ON 114 OFF --	DATE	30 April 69	OVERALL TIME	1820-2014

TEMPERATURES (°F)

Inlet Duct	282	Manifold	266
Upper Fabric	261	Lower Fabric	250
Outlet Duct	249		

FLOWS (ACFM)

Total House	10100	Deflation	3250
Comp. "A"	2975	Comp. "C"	3100
Comp. "B"	2800	Comp. "D"	3700

SO_2 LEVELS (PPM)

Inlet -	From	680	To	960	Avg	818.8
Outlet -	From	460	To	740	Avg	576.2

Average Efficiency 29.6 %

PRESSURE DROPS "H_2O

House -	From	3.0	To	6.3	Avg	4.75
Comp. "A" -	From	2.0	To	5.15	Avg	3.73
Comp. "B" -	From	2.35	To	5.85	Avg	4.19
Comp. "C" -	From	2.20	To	5.60	Avg	4.00
Comp. "D" -	From	1.85	To	5.35	Avg	3.83

ADDITIVE

Feed Location Inlet Manifold

Rate 3.11 #/Min. Total 355 # For 114 Min.

FLYASH

Corrected Inlet Grain Loading 1.29 Grains/Ft^3

Total For Test Period 226.6 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	23	10.8	31.0	69.0		
	Comp. "B"	74	34.6	18.1	81.9		
	Comp. "C"	75	35.0	13.0	87.0		
	Comp. "D"	42	19.6	15.9	84.1		
	Total	214	100.0		82.7	Not Available	
SHAKEDOWN -	Comp. "A"	24.5	17.1	56.3	43.7		
	Comp. "B"	35.5	24.8	45.8	54.2		
	Comp. "C"	51.5	36.1	49.8	50.2		
	Comp. "D"	31.5	22.0	45.8	54.2		
	Total	143	100.0		51.0	Not Available	
DEFLATION - TOTAL				47.4	52.6	Not Available	

REMARKS

TEST NO.	L-8	FLOW (ACFM)	10000	TEMP (°F)	283
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.131
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	42.5	UTILIZATION (%)	37.0
CYCLE TIME	ON 145 OFF --	DATE	30 May '69	OVERALL TIME	1548-1813

TEMPERATURES (°F)	Inlet Duct	283	Manifold	268
	Upper Fabric	261	Lower Fabric	251
	Outlet Duct	250		

FLOWS (ACFM)	Total House	10000	Deflation	3250
	Comp. "A"	2775	Comp. "C"	3150
	Comp. "B"	2700	Comp. "D"	3700

SO_2 LEVELS (PPM)	Inlet -	From	780	To	1340	Avg	1047.4
	Outlet -	From	460	To	1080	Avg	602.0

Average Efficiency 42.5 %

PRESSURE DROPS "H_2O	House -	From	3.5	To	7.6	Avg	5.70
	Comp. "A" -	From	2.50	To	6.65	Avg	4.69
	Comp. "B" -	From	3.10	To	7.20	Avg	5.27
	Comp. "C" -	From	2.65	To	6.85	Avg	4.94
	Comp. "D" -	From	2.55	To	6.75	Avg	4.47

ADDITIVE Feed Location Inlet Manifold

Rate 3.67 #/Min. Total 532 # For 145 Min.

FLYASH Corrected Inlet Grain Loading 1.28 Grains/Ft^3

Total For Test Period 220.1 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	25	9.5	15.5	84.5		
	Comp. "B"	79	30.0	11.5	88.5		
	Comp. "C"	98	37.3	13.4	86.6		
	Comp. "D"	61	23.2	13.7	86.3		
	Total	263	100.0		86.9	Not Available	
SHAKEDOWN -	Comp. "A"	51	23.7	64.7	35.3		
	Comp. "B"	45	20.9	44.2	55.8		
	Comp. "C"	68.5	31.9	45.0	55.0		
	Comp. "D"	50.5	23.5	46.6	53.4		
	Total	215	100.0		50.1	0.44	19.72
DEFLATION - TOTAL				44.8	55.2	Not Available	

REMARKS

TEST NO.	L-9	FLOW (ACFM)	9900	TEMP (°F)	284
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	3.179
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	31.6	UTILIZATION (%)	9.77
CYCLE TIME	ON 161 OFF 0	DATE	1 May '69	OVERALL TIME	0954-1235

TEMPERATURES (°F)	Inlet Duct	284	Manifold	264
	Upper Fabric	260	Lower Fabric	252
	Outlet Duct	250		

FLOWS (ACFM)	Total House	9900	Deflation	3250
	Comp. "A"	2700	Comp. "C"	2975
	Comp. "B"	2625	Comp. "D"	3400

SO_2 LEVELS (PPM)	Inlet -	From	760	To	1040	Avg	873.6
	Outlet -	From	470	To	860	Avg	597.4

Average Efficiency 31.6 %

PRESSURE DROPS "H_2O	House -	From	3.6	To	8.6	Avg	6.1
	Comp. "A" -	From	2.50	To	7.20	Avg	5.10
	Comp. "B" -	From	3.05	To	8.15	Avg	5.78
	Comp. "C" -	From	3.00	To	7.90	Avg	5.45
	Comp. "D" -	From	2.75	To	7.75	Avg	5.25

ADDITIVE

Feed Location Inlet Manifold

Rate 8.51 #/Min. Total 1370 # For 161 Min.

FLYASH

Corrected Inlet Grain Loading 1.28 Grains/Ft^3

Total For Test Period 291.9 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	70	14.3	11.2	88.8		
	Comp. "B"	177	36.3	9.7	90.3		
	Comp. "C"	137	28.1	10.1	89.9		
	Comp. "D"	104	21.3	9.0	91.0		
	Total	488	100.0		90.1	Not Available	
SHAKEDOWN -	Comp. "A"	95	27.7	56.3	43.7		
	Comp. "B"	85	24.8	43.3	56.7		
	Comp. "C"	88.5	25.8	43.9	56.1		
	Comp. "D"	74.5	21.7	52.9	47.1		
	Total	343	100.0		50.9	0.65	8.23
DEFLATION - TOTAL				46.0	54.0	Not Available	

REMARKS

TEST NO.	L-9A	FLOW (ACFM)	10000	TEMP (°F)	292
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	2.50
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	31.9	UTILIZATION (%)	13.34
CYCLE TIME	ON 161 OFF --	DATE	1 May '69	OVERALL TIME	1302-1543

TEMPERATURES (°F)

Inlet Duct	292	Manifold	265
Upper Fabric	264	Lower Fabric	255
Outlet Duct	253		

FLOWS (ACFM)

Total House	10000	Deflation	3250
Comp. "A"	2700	Comp. "C"	2850
Comp. "B"	2550	Comp. "D"	3300

SO_2 LEVELS (PPM)

Inlet -	From 770	To 1100	Avg 881.6
Outlet -	From 370	To 770	Avg 600.1

Average Efficiency 31.9%

PRESSURE DROPS "H_2O

House -	From 3.50	To 8.30	Avg 6.00
Comp. "A" -	From 2.50	To 7.20	Avg 4.85
Comp. "B" -	From 2.40	To 7.85	Avg 5.65
Comp. "C" -	From 2.75	To 7.60	Avg 5.30
Comp. "D" -	From 2.65	To 7.50	Avg 5.14

ADDITIVE

Feed Location Inlet Duct

Rate 6.15 #/Min. Total 990 # For 161 Min.

FLYASH

Corrected Inlet Grain Loading 1.27 Grains/Ft^3

Total For Test Period 291.8#

		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
COLLECTION FALLOUT -	Comp. "A"	94	16.5	10.9	89.1		
	Comp. "B"	191	33.5	12.7	87.3		
	Comp. "C"	194	34.0	13.3	86.7		
	Comp. "D"	92	16.0	9.6	90.4		
	Total	571	100.0		87.9	Not Available	
SHAKEDOWN -	Comp. "A"	99	25.0	48.4	51.6		
	Comp. "B"	101	25.5	46.2	53.8		
	Comp. "C"	106.5	26.9	44.5	55.5		
	Comp. "D"	89.5	22.6	48.8	51.2		
	Total	396	100.0		53.1	Not Available	
DEFLATION - TOTAL				49.2	50.8	Not Available	

REMARKS

TEST NO.	L-10	FLOW (ACFM)	9800	TEMP (°F)	271
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	3.657
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	67.7	UTILIZATION (%)	18.06
CYCLE TIME	ON 180 OFF --	DATE	2 June 69	OVERALL TIME	1104-1404

TEMPERATURES (°F)	Inlet Duct	271	Manifold	262
	Upper Fabric	260	Lower Fabric	251
	Outlet Duct	248		

FLOWS (ACFM)	Total House	9800	Deflation	3350
	Comp. "A"	3300	Comp. "C"	2850
	Comp. "B"	2400	Comp. "D"	3100

SO_2 LEVELS (PPM)	Inlet -	From	840	To	1160	Avg	997
	Outlet -	From	240	To	500	Avg	322

Average Efficiency 67.7 %

PRESSURE DROPS "H_2O	House -	From	3.10	To	7.50	Avg	5.5
	Comp. "A" -	From	2.20	To	6.70	Avg	4.80
	Comp. "B" -	From	2.55	To	7.15	Avg	5.02
	Comp. "C" -	From	2.20	To	6.85	Avg	4.87
	Comp. "D" -	From	2.10	To	6.85	Avg	4.69

ADDITIVE Feed Location Solenoid Valves

Rate 11.25#/Min. Total 2025 # For 180 Min.

FLYASH Corrected Inlet Grain Loading 1.31 Grains/Ft^3

Total For Test Period 328.9 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	405	30	3.1	96.9		
	Comp. "B"	562	41.6	15.3	84.8		
	Comp. "C"	242	17.9	21.8	78.2		
	Comp. "D"	142	10.5	4.5	95.5		
	Total	1351	100.0		88.4	Not Available	
SHAKEDOWN -	Comp. "A"	80	37.3	25.9	74.1		
	Comp. "B"	22.5	10.5	22.1	77.9		
	Comp. "C"	23.5	11.0	38.1	61.9		
	Comp. "D"	89.5	41.7	29.6	70.4		
	Total	214.5	100.0		72.0	0.59	21.62
DEFLATION - TOTAL				28.2	71.8	Not Available	

REMARKS

TEST NO.	L-11	FLOW (ACFM)	10000	TEMP (°F)	280
OPERATION	Parallel	TYPE FEED	Batch	STOICH. RATIO	.979
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	35.0	UTILIZATION (%)	35.7
CYCLE TIME	ON 120 OFF --	DATE	30 April 69	OVERALL TIME	1037-1252

TEMPERATURES (°F)	Inlet Duct	280	Manifold	270
	Upper Fabric	263	Lower Fabric	250
	Outlet Duct	248		

FLOWS (ACFM)	Total House	10000	Deflation	3250
	Comp. "A"	2900	Comp. "C"	3200
	Comp. "B"	2800	Comp. "D"	3775

SO_2 LEVELS (PPM)	Inlet	From	1150	To	1490	Avg	1286.8
	Outlet	From	220	To	1300	Avg	837.0

Average Efficiency 35.0 %

PRESSURE DROPS "H_2O	House	From	4.0	To	7.2	Avg	5.85
	Comp. "A"	From	3.25	To	5.85	Avg	4.95
	Comp. "B"	From	3.45	To	6.70	Avg	5.47
	Comp. "C"	From	3.00	To	6.25	Avg	4.98
	Comp. "D"	From	3.05	To	6.30	Avg	5.03

ADDITIVE

Feed Location Inlet Manifold

Rate 43.72 #/Min. Total 470 # For 10.75 Min.

FLYASH

Corrected Inlet Grain Loading 1.30 Grains/Ft^3

Total For Test Period 221.0 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	15	6.8	29.9	70.1		
	Comp. "B"	95	43.0	8.8	91.2		
	Comp. "C"	94	42.5	12.2	87.8		
	Comp. "D"	17	7.7	32.4	67.6		
	Total	221	100.0		86.5	Not Available	
SHAKEDOWN -	Comp. "A"	19.5	12.6	66.3	33.7		
	Comp. "B"	65.0	42.1	48.3	51.7		
	Comp. "C"	37.5	24.3	54.1	45.9		
	Comp. "D"	32.5	21.0	61.0	39.0		
	Total	154.5	100.0		45.3	.27	19.61
DEFLATION - TOTAL				40.4	59.6	Not Available	

REMARKS

TEST NO.	L-12	FLOW (ACFM)	10,250	TEMP (°F)	283
OPERATION	Parallel	TYPE FEED	Batch	STOICH. RATIO	2.794
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	63.7	UTILIZATION (%)	22.3
CYCLE TIME	ON 60 OFF --	DATE	30 April 69	OVERALL TIME	1257-1357

TEMPERATURES (°F)

Inlet Duct	283	Manifold	270
Upper Fabric	265	Lower Fabric	251
Outlet Duct	250		

FLOWS (ACFM)

Total House	10250	Deflation	3300
Comp. "A"	1180	Comp. "C"	3200
Comp. "B"	2900	Comp. "D"	3700

SO_2 LEVELS (PPM)

Inlet -	From	1190	To	1600	Avg	1296.3
Outlet -	From	1180	To	170	Avg	471.2

Average Efficiency 63.7 %

PRESSURE DROPS "H_2O

House -	From	3.60	To	5.75	Avg	4.80
Comp. "A" -	From	2.45	To	4.70	Avg	3.79
Comp. "B" -	From	3.10	To	5.15	Avg	4.23
Comp. "C" -	From	2.55	To	4.80	Avg	3.78
Comp. "D" -	From	2.35	To	4.75	Avg	3.85

ADDITIVE

Feed Location Inlet Manifold

Rate 42.46#/Min. Total 690 # For 16.25 Min.

FLYASH

Corrected Inlet Grain Loading 1.28 Grains/Ft^3

Total For Test Period 112.8 #

COLLECTION

		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	58	15.8	18.4	81.6		
	Comp. "B"	137	37.2	6.2	93.8		
	Comp. "C"	108	29.3	6.6	93.4		
	Comp. "D"	65	17.7	8.7	91.3		
	Total	368	100.0		91.3	0.39	1.47
SHAKEDOWN -	Comp. "A"	17.5	14.7	49.7	50.3		
	Comp. "B"	52	43.7	37.6	62.4		
	Comp. "C"	33.5	28.2	36.5	63.5		
	Comp. "D"	16	13.4	36.7	63.3		
	Total	119	100.0		61.1	0.48	24.33
DEFLATION - TOTAL				46.4	53.6	0.41	20.55

REMARKS

TEST NO.	L-13	FLOW (ACFM)	9875	TEMP (°F)	351
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.893
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	56.0	UTILIZATION (%)	62.3
CYCLE TIME	ON 120 OFF ___	DATE	8 May '69	OVERALL TIME	1450-1650

TEMPERATURES (°F)

Inlet Duct	351	Manifold	332
Upper Fabric	323	Lower Fabric	302
Outlet Duct	296		

FLOWS (ACFM)

Total House	9875	Deflation	3550
Comp. "A"	2500	Comp. "C"	2550
Comp. "B"	1900	Comp. "D"	2200

SO_2 LEVELS (PPM)

Inlet -	From 1000	To 1380	Avg 1132.2
Outlet -	From 380	To 1000	Avg 497.9

Average Efficiency 56.0 %

PRESSURE DROPS "H_2O

House -	From 2.90	To 5.15	Avg 4.02
Comp. "A" -	From 2.20	To 4.40	Avg 3.30
Comp. "B" -	From 2.65	To 4.75	Avg 3.80
Comp. "C" -	From 2.40	To 4.70	Avg 3.55
Comp. "D" -	From 2.25	To 4.55	Avg 3.40

ADDITIVE Feed Location Solenoid Valves

Rate 2.83 #/Min. Total 340 # For 120 Min.

FLYASH Corrected Inlet Grain Loading 1.18 Grains/Ft^3

Total For Test Period 199.1 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	7	6.4	32.0	68.0		
	Comp. "B"	15	13.8	30.4	69.6		
	Comp. "C"	30	27.5	18.6	81.4		
	Comp. "D"	57	52.3	7.1	92.9		
	Total	109	100.0		84.9	Not Available	
SHAKEDOWN -	Comp. "A"	30.5	19.7	56.7	43.3		
	Comp. "B"	39.0	25.2	57.0	43.0		
	Comp. "C"	43.5	28.1	57.0	43.0		
	Comp. "D"	42.0	27.1	40.1	59.9		
	Total	155.0	100.0		47.63	Not Available	
DEFLATION - TOTAL				Not Available		Not Available	

REMARKS

TEST NO.	L-14	FLOW (ACFM)	14,900	TEMP (°F)	312
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.137
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	39.05	UTILIZATION (%)	33.86
CYCLE TIME	ON 55 OFF --	DATE	5 May '69	OVERALL TIME	1140-1235

TEMPERATURES (°F)

Inlet Duct	312	Manifold	290
Upper Fabric	287	Lower Fabric	276
Outlet Duct	275		

FLOWS (ACFM)

Total House	14900	Deflation	3675
Comp. "A"	4100	Comp. "C"	4100
Comp. "B"	3550	Comp. "D"	4800

SO_2 LEVELS (PPM)

	From	To	Avg
Inlet	1100	1590	1259.30
Outlet	420	1260	767.54

Average Efficiency 39.05 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	5.3	9.3	7.49
Comp. "A"	3.00	7.10	5.58
Comp. "B"	4.05	8.05	6.35
Comp. "C"	3.70	7.90	6.00
Comp. "D"	3.65	7.45	5.65

ADDITIVE

Feed Location Solenoid Valves

Rate 6.36 #/Min. Total 350 # For 55 Min.

FLYASH

Corrected Inlet Grain Loading 1.24 Grains/Ft^3

Total For Test Period 144.7 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	35	16.4	16.0	84.0		
	Comp. "B"	82	38.5	18.1	81.9		
	Comp. "C"	89	41.8	24.1	75.9		
	Comp. "D"	7	3.3	96.01	3.99		
	Total	213	100.0		78.4	Not Available	
SHAKEDOWN -	Comp. "A"	30.5	22.8	54.6	45.4		
	Comp. "B"	39.0	29.1	58.8	41.2		
	Comp. "C"	44.0	32.8	62.4	37.6		
	Comp. "D"	20.5	15.3	92.08	7.92		
	Total	134.0	100.0		46.8	Not Available	
DEFLATION - TOTAL				67.0	33.0	Not Available	

REMARKS

TEST NO.	M-1	FLOW (ACFM)	10250	TEMP (°F)	353
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.77
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	41.7	UTILIZATION (%)	53.8
CYCLE TIME	ON 30 OFF 10	DATE	6 May '69	OVERALL TIME	1035-1225

TEMPERATURES (°F)

Inlet Duct	353	Manifold	330
Upper Fabric	323	Lower Fabric	300
Outlet Duct	290		

FLOWS (ACFM)

Total House	10250	Deflation	3775
Comp. "A"	2825	Comp. "C"	3450
Comp. "B"	3150	Comp. "D"	3850

SO_2 LEVELS (PPM)

	From	To	Avg
Inlet	1744	1496	1634.2
Outlet	1116	728	952.4

Average Efficiency 41.7 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	5.5	4.75	5.08
Comp. "A"	3.70	4.45	4.15
Comp. "B"	3.95	4.65	4.37
Comp. "C"	3.50	4.60	4.07
Comp. "D"	3.65	4.45	4.12

ADDITIVE Feed Location Solenoid Valves

Rate 3.65 #/Min. Total 146 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 68.7 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	13	14.6	29.2	70.8		
	Comp. "B"	17	19.1	40.9	59.1		
	Comp. "C"	27	30.3	36.7	63.3		
	Comp. "D"	32	36.0	7.9	92.1		
	Total	89	100.0		73.9	Not Available	
SHAKEDOWN -	Comp. "A"	8	25.0	45.1	54.9		
	Comp. "B"	7	21.9	61.4	38.6		
	Comp. "C"	7	21.9	50.7	49.3		
	Comp. "D"	10	31.2	32.8	67.2		
	Total	32	100.0		54.0	1.0	26.03
DEFLATION - TOTAL				61.3	38.7	0.82	16.74

REMARKS

TEST NO.	M-2	FLOW (ACFM)	10250	TEMP (°F)	349
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	3.250
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	69.9	UTILIZATION (%)	21.3
CYCLE TIME	ON 30 OFF 10	DATE	5 May '69	OVERALL TIME	1339-1619

TEMPERATURES (°F)
Inlet Duct 349 Manifold 334
Upper Fabric 320 Lower Fabric 296
Outlet Duct 283

FLOWS (ACFM)
Total House 10250 Deflation 3675
Comp. "A" 3150 Comp. "C" 3300
Comp. "B" 2800 Comp. "D" 3150

SO_2 LEVELS (PPM)
Inlet - From 1368 To 1030 Avg 1161.5
Outlet - From 496 To 146 Avg 349.0
Average Efficiency 69.9 %

PRESSURE DROPS "H_2O"

	From	To	Avg
House	5.5	4.75	4.44
Comp. "A"	2.90	3.60	3.23
Comp. "B"	3.30	4.00	3.72
Comp. "C"	2.85	3.75	3.28
Comp. "D"	2.70	4.05	3.43

ADDITIVE Feed Location Solenoid Valves
Rate 11.0 #/Min. Total 440 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 1.18 Grains/Ft^3
Total For Test Period 69.1 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	76	35.8	6.3	93.7		
	Comp. "B"	72	34.0	8.2	91.8		
	Comp. "C"	7	3.3	83.3	16.7		
	Comp. "D"	57	29.6	5.5	94.5		
	Total	212	100.0		90.7	Not Available	
SHAKEDOWN -	Comp. "A"	19	31.1	24.5	75.5		
	Comp. "B"	19	31.1	28.4	71.6		
	Comp. "C"	5.5	9.1	78.1	21.9		
	Comp. "D"	17.5	28.7	26.1	73.9		
	Total	61	100.0		69.0	Not Available	
DEFLATION -	TOTAL			36.2	63.8	Not Available	

REMARKS

TEST NO.	M-3	FLOW (ACFM)	10300	TEMP (°F)	349
OPERATION	Cyclic	TYPE FEED	Batch	STOICH. RATIO	.936
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	47.9	UTILIZATION (%)	51.8
CYCLE TIME	ON 30 OFF 10	DATE	7 May '69	OVERALL TIME	0930-1115

TEMPERATURES (°F)

Inlet Duct	349	Manifold	325
Upper Fabric	314	Lower Fabric	291
Outlet Duct	290		

FLOWS (ACFM)

Total House	10300	Deflation	3200
Comp. "A"	3100	Comp. "C"	3500
Comp. "B"	3150	Comp. "D"	3900

SO_2 LEVEL (PPM)

Inlet	From	1114	To	876	Avg	996.2
Outlet	From	702	To	350	Avg	514.4

Average Efficiency 47.9 %

PRESSURE DROPS "H_2O

House	From	5.95	To	5.05	Avg	5.53
Comp. "A"	From	4.30	To	4.70	Avg	4.51
Comp. "B"	From	4.45	To	5.20	Avg	4.84
Comp. "C"	From	3.95	To	4.80	Avg	4.64
Comp. "D"	From	3.95	To	4.70	Avg	4.35

ADDITIVE

Feed Location Solenoid Valves

Rate 9.91 #/Min. Total 109 # For 11 Min.

FLYASH

Corrected Inlet Grain Loading 1.18 Grains/Ft^3

Total For Test Period 69.4 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	18	25.7	24.2	75.8		
	Comp. "B"	15	21.4	47.5	52.5		
	Comp. "C"	20	28.6	45.5	54.5		
	Comp. "D"	17	24.3	35.6	64.4		
	Total	70	100.0		70.0	0.47	3.61
SHAKEDOWN -	Comp. "A"	7.5	24.6	64.9	35.1		
	Comp. "B"	8.0	26.2	67.6	32.4		
	Comp. "C"	8.0	26.2	64.2	35.8		
	Comp. "D"	7.0	23.0	60.8	39.2		
	Total	30.5	100.0		35.5	0.86	17.57
DEFLATION - TOTAL				67.7	32.3	0.75	15.25

REMARKS

TEST NO.	M-4	FLOW (ACFM)	10250	TEMP (°F)	354
OPERATION	Cyclic	TYPE FEED	Batch	STOICH. RATIO	3.097
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	79.0	UTILIZATION (%)	25.5
CYCLE TIME	ON 30 OFF 10	DATE	5 May '69	OVERALL TIME	1737-1927

TEMPERATURES (°F)	Inlet Duct	354	Manifold	334
	Upper Fabric	320	Lower Fabric	296
	Outlet Duct	295		

FLOWS (ACFM)	Total House	10250	Deflation	3675
	Comp. "A"	3300	Comp. "C"	3100
	Comp. "B"	2700	Comp. "D"	3100

SO_2 LEVELS (PPM)	Inlet -	From 1176	To 1006	Avg 1103.5
	Outlet -	From 400	To 170	Avg 231.8

Average Efficiency 79 %

PRESSURE DROPS "H_2O	House -	From 5.4	To 4.55	Avg 4.98
	Comp. "A" -	From 3.05	To 4.0	Avg 3.55
	Comp. "B" -	From 3.30	To 3.95	Avg 3.69
	Comp. "C" -	From 3.15	To 3.85	Avg 3.48
	Comp. "D" -	From 3.10	To 3.75	Avg 3.45

ADDITIVE

Feed Location Solenoid Valves

Rate 44 #/Min. Total 396 # For 9 Min.

FLYASH

Corrected Inlet Grain Loading 1.18 Grains/Ft^3

Total For Test Period 68.6 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	58	26.4	7.2	92.8		
	Comp. "B"	47	21.3	16.5	83.5		
	Comp. "C"	60	27.3	13.3	86.7		
	Comp. "D"	55	25.0	8.6	91.4		
	Total	220	100.0		88.8	0.60	1.21
SHAKEDOWN -	Comp. "A"	14.0	28.0	37.2	62.8		
	Comp. "B"	10.0	20.0	39.0	61.0		
	Comp. "C"	13.5	27.0	41.9	58.1		
	Comp. "D"	12.5	25.0	38.0	62.0		
	Total	50.0	100.0		61.0	1.19	23.74
DEFLATION -	TOTAL			42.1	57.9	0.98	19.55

REMARKS

TEST NO.	M-5	FLOW (ACFM)	10000	TEMP (°F)	354
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.010
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	49.4	UTILIZATION (%)	48.9
CYCLE TIME	ON 122 OFF	DATE	6 May '69	OVERALL TIME	1630-1845

TEMPERATURES (°F)	Inlet Duct	354	Manifold	333
	Upper Fabric	323	302 Lower Fabric	
	Outlet Duct	300		

FLOWS (ACFM)	Total House	10000	Deflation	3600
	Comp. "A"	2650	Comp. "C"	2775
	Comp. "B"	2775	Comp. "D"	3200

SO_2 LEVELS (PPM)	Inlet - From	1840	To	1460	Avg	1624.4
	Outlet - From	960	To	660	Avg	821.6

Average Efficiency 49.4 %

PRESSURE DROPS "H_2O	House - From	6.7	To	3.45	Avg	5.03
	Comp. "A" - From	2.55	To	5.30	Avg	3.93
	Comp. "B" - From	3.05	To	6.30	Avg	4.58
	Comp. "C" - From	2.70	To	6.10	Avg	4.24
	Comp. "D" - From	2.65	To	5.95	Avg	3.97

ADDITIVE

Feed Location Solenoid Valves

Rate 4.63 #/Min. Total 565 # For 122 Min.

FLYASH

Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 204.3 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	26	10.4	19.5	80.5		
	Comp. "B"	47	18.9	26.0	74.0		
	Comp. "C"	81	32.5	14.4	85.6		
	Comp. "D"	95	38.2	7.5	92.5		
	Total	249	100.0		85.5	Not Available	
SHAKEDOWN -	Comp. "A"	58.0	24.9	49.6	50.4		
	Comp. "B"	58.0	24.9	57.2	42.8		
	Comp. "C"	59.5	25.5	53.9	46.1		
	Comp. "D"	57.5	24.7	36.1	63.9		
	Total	233	100.0		50.7	0.70	29.35
DEFLATION - TOTAL				54.3	45.7	0.54	25.44

REMARKS

TEST NO.	M-6	FLOW (ACFM)	10250	TEMP (°F)	350
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	2.79
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	77.52	UTILIZATION (%)	27.46
CYCLE TIME	ON 135 OFF --	DATE	6 May '69	OVERALL TIME	1630-1845

TEMPERATURES (°F)	Inlet Duct	350	Manifold	330
	Upper Fabric	317	Lower Fabric	300
	Outlet Duct	290		

FLOWS (ACFM)	Total House	10250	Deflation	3675
	Comp. "A"	2800	Comp. "C"	2750
	Comp. "B"	2250	Comp. "D"	3050

SO_2 LEVELS (PPM)	Inlet -	From	1770	To	1380	Avg	1523.6
	Outlet -	From	1000	To	270	Avg	342.6

Average Efficiency 77.52 %

PRESSURE DROPS "H_2O	House -	From	8.6	To	3.3	Avg	6.08
	Comp. "A" -	From	2.45	To	7.80	Avg	5.04
	Comp. "B" -	From	3.05	To	8.15	Avg	5.60
	Comp. "C" -	From	2.70	To	7.90	Avg	5.30
	Comp. "D" -	From	2.65	To	7.65	Avg	5.15

ADDITIVE Feed Location Solenoid Valves

Rate 12.37#/Min. Total 1670 # For 135 Min.

FLYASH Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 232.8 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	270	32.3	3.3	96.7	0.42	1.07
	Comp. "B"	357	42.7	4.3	95.7	0.45	0.94
	Comp. "C"	92	11.0	16.0	84.0	0.36	1.82
	Comp. "D"	117	14.0	5.8	94.2	0.42	2.72
	Total	836	100.0		94.5	0.43	1.33
SHAKEDOWN -	Comp. "A"	95.0	22.4	29.6	70.4	1.54	31.20
	Comp. "B"	140.0	33.0	33.1	66.9	1.18	22.01
	Comp. "C"	79.5	18.8	51.0	49.0	0.86	27.77
	Comp. "D"	109.5	25.8	33.6	66.4	1.24	30.49
	Total	424	100.0		64.2	1.22	27.34
DEFLATION -	TOTAL			38.7	61.3	0.61	23.73

REMARKS

TEST NO.	M-7	FLOW (ACFM)	10250	TEMP (°F)	350
OPERATION	Baralle1	TYPE FEED	Batch	STOICH. RATIO	1.103
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	38.9	UTILIZATION (%)	35.2
CYCLE TIME	ON 120 OFF	DATE	7 May '69	OVERALL TIME	1350-1550

TEMPERATURES (°F)

Inlet Duct	350	Manifold	326
Upper Fabric	319	Lower Fabric	296
Outlet Duct	290		

FLOWS (ACFM)

Total House	10250	Deflation	3675
Comp. "A"	2575	Comp. "C"	2950
Comp. "B"	2450	Comp. "D"	3500

SO_2 LEVELS (PPM)

Inlet -	From	1030	To	780	Avg	907.8
Outlet -	From	870	To	200	Avg	555.5

Average Efficiency 38.9 %

PRESSURE DROPS "H_2O

House -	From	5.6	To	3.4	Avg	4.78
Comp. "A" -	From	2.65	To	4.70	Avg	3.77
Comp. "B" -	From	3.05	To	5.05	Avg	4.26
Comp. "C" -	From	2.70	To	4.70	Avg	[illegible]
Comp. "D" -	From	2.45	To	4.75	Avg	3.81

ADDITIVE

Feed Location Solenoid Valves

Rate 25 #/Min. Total 350 # For 14 Min.

FLYASH

Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 207.0 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	28	22.4	10.6	89.4		
	Comp. "B"	70	56.0	15.1	84.9		
	Comp. "C"	10	8.0	63.3	36.7		
	Comp. "D"	17	13.6	14.2	85.8		
	Total	125	100.0		82.2	0.44	0.56
SHAKEDOWN -	Comp. "A"	23.5	26.7	59.8	40.2		
	Comp. "B"	24.0	27.3	53.6	46.4		
	Comp. "C"	19.0	21.6	83.9	16.1		
	Comp. "D"	21.5	24.4	59.8	40.2		
	Total	88.0	100.0		36.7	0.75	17.35
DEFLATION -	TOTAL			64.2	35.8	0.80	16.49

REMARKS

TEST NO.	M-8	FLOW (ACFM)	10350	TEMP (°F)	349
OPERATION	Parallel	TYPE FEED	Batch	STOICH. RATIO	2.917
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	60.7	UTILIZATION (%)	20.8
CYCLE TIME	ON 60 OFF --	DATE	7 May '69	OVERALL TIME	1130-1230

TEMPERATURES (°F)

Inlet Duct	349	Manifold	324
Upper Fabric	314	Lower Fabric	291
Outlet Duct	286		

FLOWS (ACFM)

Total House	10356	Deflation	3600
Comp. "A"	2600	Comp. "C"	2950
Comp. "B"	2450	Comp. "D"	3550

SO_2 LEVELS (PPM)

Inlet	From 1140	To 900	Avg 1009.1
Outlet	From 980	To 190	Avg 396.4

Average Efficiency 60.7 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	5.05	3.2	4.34
Comp. "A"	2.60	4.05	3.43
Comp. "B"	2.95	4.65	3.99
Comp. "C"	2.50	4.30	3.54
Comp. "D"	2.35	4.05	3.29

ADDITIVE

Feed Location Solenoid Valves

Rate 38.52#/Min. Total 520 # For 13.5 Min.

FLYASH

Corrected Inlet Grain Loading 1.18 Grains/Ft^3

Total For Test Period 104.6 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	43	20.8	6.6	93.4		
	Comp. "B"	132	63.7	4.3	95.7		
	Comp. "C"	8	3.9	41.2	58.8		
	Comp. "D"	24	11.6	8.3	91.7		
	Total	207	100.0		93.3	Not Available	
SHAKEDOWN -	Comp. "A"	15.0	20.5	40.5	59.5		
	Comp. "B"	31.0	42.5	44.6	55.4		
	Comp. "C"	12.5	17.1	74.9	25.1		
	Comp. "D"	14.5	19.9	48.9	51.1		
	Total	73.0	100.0		50.2	Not Available	
DEFLATION - TOTAL				48.7	51.3	Not Available	

REMARKS

TEST NO.	M-9	FLOW (ACFM)	10,100	TEMP (°F)	350
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	.82
ADDITIVE	Nacholite	AVG SO_2 REMOVAL (%)	65.1	UTILIZATION (%)	79.9
CYCLE TIME	ON 30 OFF 10	DATE	June 5, 1969	OVERALL TIME	08:36 - 10:35

TEMPERATURES (°F)

Inlet Duct	350	Manifold	333
Upper Fabric	327	Lower Fabric	305
Outlet Duct	305		

FLOWS (ACFM)

Total House	10,100	Deflation	3,600
Comp. "A"	1,750	Comp. "C"	3,700
Comp. "B"		Comp. "D"	2,600

SO_2 LEVELS (PPM)

Inlet	From	780	To	1,000	Avg	870.2
Outlet	From	260	To	380	Avg	303.8

Average Efficiency 65.1 %

PRESSURE DROPS "H_2O

House	From	4.75	To	5.45	Avg	5.08
Comp. "A"	From	3.30	To	4.00	Avg	3.69
Comp. "B"	From	3.50	To	4.30	Avg	3.88
Comp. "C"	From	3.10	To	4.15	Avg	3.63
Comp. "D"	From	3.45	To	4.85	Avg	3.97

ADDITIVE

Feed Location Solenoid Valves

Rate 2.92 #/Min. Total 350 # For 120 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 188.8 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	12	23.5				
	Comp. "B"	12	23.5				
	Comp. "C"	15	29.5				
	Comp. "D"	12	23.5				
	Total	51	100.0		Not Available	Not Available	
SHAKEDOWN -	Comp. "A"	16	26.0				
	Comp. "B"	17	27.6				
	Comp. "C"	15.5	25.2				
	Comp. "D"	13	21.2				
	Total	61.5	100.0		Not Available	Not Available	
DEFLATION - TOTAL					Not Available	Not Available	

REMARKS

TEST NO.	M-10	FLOW (ACFM)	10,500	TEMP (°F)	352
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.75
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	66.03	UTILIZATION (%)	89.7
CYCLE TIME	ON 60 OFF --	DATE	June 5, 1969	OVERALL TIME	10:39 - 11:39

TEMPERATURES (°F)

Inlet Duct	352	Manifold	335
Upper Fabric	330	Lower Fabric	306
Outlet Duct	302		

FLOWS (ACFM)

Total House	10,500	Deflation	4,400
Comp. "A"	1250	Comp. "C"	3,700
Comp. "B"	1,950	Comp. "D"	2,600

SO_2 LEVELS (PPM)

	From	To	Avg
Inlet	810	1,080	930
Outlet	230	450	316

Average Efficiency 66.03 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	3.55	4.70	4.15
Comp. "A"	2.30	3.50	2.90
Comp. "B"	2.50	3.75	3.15
Comp. "C"	2.35	3.55	2.95
Comp. "D"	2.50	3.79	3.15

ADDITIVE Feed Location Solenoid Valve

Rate 2.97 #/Min. Total 178 # For 60 Min.

FLYASH Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 99.0 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	9	60.0				
	Comp. "B"	0*	0*				
	Comp. "C"	2	13.3				
	Comp. "D"	4	26.7				
	Total	15	100.0		Not Available	Not Available	
SHAKEDOWN -	Comp. "A"	26	18.8				
	Comp. "B"	38.5	27.8				
	Comp. "C"	42	30.3				
	Comp. "D"	32	23.1				
	Total	138.5	100.0		Not Available	Not Available	
DEFLATION - TOTAL					Not Available	Not Available	

REMARKS *Scales not accurate, more in "B" than "A"

TEST NO. M-11 · FLOW (ACFM) 10,250 TEMP (°F) 353

OPERATION Cyclic TYPE FEED Continuous STOICH. RATIO 2.64

ADDITIVE Nahcolite AVG SO_2 REMOVAL (%) 91.4 UTILIZATION (%) 34.6

CYCLE TIME ON 30 OFF 10 DATE June 5, 1969 OVERALL TIME 1244-1444

TEMPERATURES (°F)

Inlet Duct	353	Manifold	332
Upper Fabric	315	Lower Fabric	304
Outlet Duct	300		

FLOWS (ACFM)

Total House	10,250	Deflation	3,500
Comp. "A"	1,800	Comp. "C"	3,850
Comp. "B"	2,900	Comp. "D"	2,500

SO_2 LEVELS (PPM)

Inlet -	From	980	To	1250	Avg	1080
Outlet -	From	60	To	200	Avg	93

Average Efficiency 91.4 %

PRESSURE DROPS "H_2O

House -	From	4.45	To	5.05	Avg	4.76
Comp. "A" -	From	3.1	To	3.7	Avg	3.42
Comp. "B" -	From	3.4	To	3.9	Avg	3.63
Comp. "C" -	From	3.0	To	3.75	Avg	3.35
Comp. "D" -	From	3.3	To	4.0	Avg	3.68

ADDITIVE Feed Location Solenoid Valves

Rate 11.88 #/Min. Total 475 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 193.2 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	57.5	25.9				
	Comp. "B"	44	19.8				
	Comp. "C"	41.5	18.7				
	Comp. "D"	79	35.6				
	Total	222	100.0		Not Available		Not Available
SHAKEDOWN -	Comp. "A"	30	26.8				
	Comp. "B"	30	26.8				
	Comp. "C"	29	25.9				
	Comp. "D"	23	20.5				
	Total	112	100.0		Not Available		Not Available
DEFLATION - TOTAL					Not Available		Not Available

REMARKS

TEST NO. M-12 FLOW (ACFM) 10,250 TEMP (°F) 354

OPERATION Cyclic TYPE FEED Batch STOICH. RATIO .985

ADDITIVE Nahcolite AVG SO_2 REMOVAL (%) 73.3 UTILIZATION (%) 76.5

CYCLE TIME ON 30 OFF 10 DATE June 6, 1969 OVERALL TIME 1219-1417

TEMPERATURES (°F)

Inlet Duct 354 Manifold 336
Upper Fabric 330 Lower Fabric 307
Outlet Duct 305

FLOWS (ACFM)

Total House 10,250 Deflation 3,500
Comp. "A" 1,700 Comp. "C" 3,900
Comp. "B" 2,700 Comp. "D" 2,350

SO_2 LEVELS (PPM)

Inlet - From 750 To 1,000 Avg 829
Outlet - From 40 To 430 Avg 222
Average Efficiency 73.3 %

PRESSURE DROPS "H_2O

House	- From 4.20	To 4.70	Avg 4.46
Comp. "A"	- From 3.0	To 3.60	Avg 3.30
Comp. "B"	- From 3.1	To 3.65	Avg 3.38
Comp. "C"	- From 3.0	To 3.65	Avg 3.31
Comp. "D"	- From 3.05	To 3.75	Avg 3.43

ADDITIVE

Feed Location Solenoid Valves

Rate 14.35#/Min. Total 132 # For 40 Min.

FLYASH

Corrected Inlet Grain Loading 1.2 Grains/Ft³

Total For Test Period 70.3 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	6	20.3				
	Comp. "B"	7.5	25.4				
	Comp. "C"	9	30.5				
	Comp. "D"	7	23.8				
	Total	29.5	100.0		8.76	0.81	2.05
SHAKEDOWN -	Comp. "A"	11	18.6				
	Comp. "B"	9	15.3				
	Comp. "C"	18.5	31.4				
	Comp. "D"	20.5	34.7				
	Total	59	100.0		14.43	1.21	15.32
DEFLATION - TOTAL					12.63	1.14	15.01

REMARKS

TEST NO.	M-13	FLOW (ACFM)	10,500	TEMP (°F)	350
OPERATION	Parallel	TYPE FEED	Batch	STOICH. RATIO	.927
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	55.7	UTILIZATION (%)	60.3
CYCLE TIME	ON 60 OFF -	DATE	June 5, 1969	OVERALL TIME	1652-1752

TEMPERATURES (°F)

Inlet Duct 350
Upper Fabric 330
Outlet Duct 298
Manifold 330
Lower Fabric 305

FLOWS (ACFM)

Total House 10,500
Comp. "A" 1,300
Comp. "B" 1,650
Deflation 4,250
Comp. "C" 3,600
Comp. "D" 1,650

SO_2 LEVELS (PPM)

Inlet - From 940 To 1190 Avg 1054
Outlet - From 120 To 940 Avg 467
Average Efficiency 55.7 %

PRESSURE DROPS "H_2O

House -	From	3.0	To	4.6	Avg	3.8
Comp. "A" -	From	2.0	To	3.4	Avg	2.7
Comp. "B" -	From	2.3	To	3.7	Avg	3.0
Comp. "C" -	From	2.3	To	3.7	Avg	3.0
Comp. "D" -	From	2.3	To	3.7	Avg	3.0

ADDITIVE

Feed Location Solenoid Valves
Rate 24.39 #/Min. Total 250 # For 10.25 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3
Total For Test Period 99.0 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	10	14.7				
	Comp. "B"	15	22.1				
	Comp. "C"	32	47.1				
	Comp. "D"	11	16.1				
	Total	68	100.0		1.91	0.37	0.61
SHAKEDOWN -	Comp. "A"	29.0	16.0				
	Comp. "B"	52.5	29.0				
	Comp. "C"	67.5	37.3				
	Comp. "D"	32.0	17.7				
	Total	181.	100.0		10.23	1.23	12.33
DEFLATION - TOTAL					9.90	1.09	11.90

REMARKS

TEST NO.	M-14	FLOW (ACFM)	10,500	TEMP (°F)	352
OPERATION	Parallel	TYPE FEED	Batch	STOICH. RATIO	2.74
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	72.3	UTILIZATION (%)	26.4
CYCLE TIME	ON 60 OFF -	DATE	June 5, 1969	OVERALL TIME	1500-1615

TEMPERATURES (°F)

Inlet Duct 352

Upper Fabric 313

Outlet Duct 288

Manifold 333

Lower Fabric 296

FLOWS (ACFM)

Total House 10,500

Comp. "A" 12,50

Comp. "B" 1,500

Deflation 4100

Comp. "C" 3,550

Comp. "D" 1650

SO_2 LEVELS (PPM)

Inlet - From 940 To 1330 Avg 1084

Outlet - From 230 To 580 Avg 300

Average Efficiency 72.3 %

PRESSURE DROPS "H_2O

		From	To	Avg
House	-	3.25	4.95	4.1
Comp. "A"	-	2.10	3.80	2.95
Comp. "B"	-	2.25	4.05	3.15
Comp. "C"	-	2.10	3.90	3.00
Comp. "D"	-	2.25	3.95	3.10

ADDITIVE

Feed Location Solenoid Valves

Rate 39 #/Min. Total 760 # For 19.5 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 133.7 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	33	18.1				
	Comp. "B"	95	52.2				
*	Comp. "C"	23	12.6				
	Comp. "D"	31	17.1				
	Total	182	100.0		11.52	0.51	0.76
SHAKEDOWN -	Comp. "A"	93	24.4				
	Comp. "B"	142	37.3				
*	Comp. "C"	34	9.0				
	Comp. "D"	112	29.3				
	Total	381	100.0		11.47	1.50	10.70
DEFLATION - TOTAL					14.35	1.50	11.60

REMARKS

* Samples include 15 min. extension (75 min. total)

TEST NO. M-15 FLOW (ACFM) 10,100 TEMP (°F) 352

OPERATION Cyclic TYPE FEED Batch STOICH. RATIO 2.882

ADDITIVE Nacholite AVG SO_2 REMOVAL (%) 89.3 UTILIZATION (%) 31.0

CYCLE TIME ON 30 OFF 10 DATE June 6, 1969 OVERALL TIME 1030-1219

TEMPERATURES (°F)

Inlet Duct 352

Upper Fabric 318

Outlet Duct 291

Manifold 333

Lower Fabric 302

FLOWS (ACFM)

Total House 10,100

Comp. "A" 1,600

Comp. "B" 2,650

Deflation 3,600

Comp. "C" 4,000

Comp. "D" 2,350

SO_2 LEVELS (PPM)

Inlet -	From	780	To	920	Avg	845
Outlet -	From	40	To	210	Avg	91

Average Efficiency 89.3 %

PRESSURE DROPS "H_2O

House -	From	4.4	To	5.00	Avg	4.68
Comp. "A" -	From	3.35	To	3.90	Avg	3.63
Comp. "B" -	From	3.40	To	4.00	Avg	3.71
Comp. "C" -	From	3.10	To	4.05	Avg	3.60
Comp. "D" -	From	3.30	To	3.90	Avg	3.63

ADDITIVE

Feed Location Solenoid Valves

Rate 22.22 #/Min. Total 400 # For 18 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 63.5 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	27	15.7				
	Comp. "B"	12	7.0				
	Comp. "C"	69.5	40.4				
	Comp. "D"	63.5	36.9				
	Total	172.	100.0		18.59	1.36	5.30
SHAKEDOWN -	Comp. "A"	24.5	21.7				
	Comp. "B"	28.5	25.2				
	Comp. "C"	34.0	30.1				
	Comp. "D"	26.0	23.0				
	Total	113.0	100.0		10.61	1.52	10.71
DEFLATION - TOTAL					14.99	1.30	10.88

REMARKS

TEST NO.	M-16	FLOW (ACFM)	10,250	TEMP (°F)	350
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	2.80
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	86.2	UTILIZATION (%)	30.8
CYCLE TIME	ON 60 OFF--	DATE	June 6, 1969	OVERALL TIME	0851-0951

TEMPERATURES (°F)

Inlet Duct 350
Upper Fabric 310
Outlet Duct 295
Manifold 331
Lower Fabric 300

FLOWS (ACFM)

Total House 10,250
Comp. "A" 1,100
Comp. "B" 1,650
Deflation 3,650
Comp. "C" 3,600
Comp. "D" 1,650

SO_2 LEVELS (PPM)

Inlet - From 840 To 1,020 Avg 925
Outlet - From 70 To 660 Avg 128
Average Efficiency 86.2 %

PRESSURE DROPS "H_2O"

House - From 3.65	To 4.6	Avg 4.13
Comp. "A" - From 2.5	To 3.5	Avg 3.0
Comp. "B" - From 2.8	To 3.85	Avg 3.32
Comp. "C" - From 2.6	To 3.65	Avg 3.13
Comp. "D" - From 2.7	To 3.25	Avg 2.98

ADDITIVE

Feed Location Solenoid Valves
Rate 10.82#/Min. Total 650 # For 60 Min.

FLYASH

Corrected Inlet Grain Loading 1.17 Grains/Ft^3
Total For Test Period 103.5#

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	10	15.2				
	Comp. "B"	7	10.6				
	Comp. "C"	17	25.8				
	Comp. "D"	32	48.4				
	Total	66	100.0		7.12	0.55	0.87
SHAKEDOWN -	Comp. "A"	43	14.1				
	Comp. "B"	45	14.7				
	Comp. "C"	93	30.4				
	Comp. "D"	125	40.8				
	Total	306	100.0		14.15	1.49	10.18
DEFLATION - TOTAL					11.12	1.08	10.62

REMARKS

TEST NO.	M-17	FLOW (ACFM)	10,250	TEMP (°F)	350
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.61
ADDITIVE	CA $(OH)_2$	AVG SO_2 REMOVAL (%)	17.9	UTILIZATION (%)	6.9
CYCLE TIME	ON 30 OFF 10	DATE	June 10, 1969	OVERALL TIME	0846-1044

TEMPERATURES (°F)

Inlet Duct	350	Manifold	334
Upper Fabric	321	Lower Fabric	306
Outlet Duct	295		

FLOWS (ACFM)

Total House	10,250	Deflation	4,250
Comp. "A"	1,600	Comp. "C"	3,400
Comp. "B"	2,500	Comp. "D"	2,400

SO_2 LEVELS (PPM)

Inlet -	From	1,760	To	1,150	Avg	1,303
Outlet -	From	1,320	To	830	Avg	1,069

Average Efficiency 17.9 %

PRESSURE DROPS "H_2O

House -	From	4.3	To	5.0	Avg	4.61
Comp. "A" -	From	3.15	To	3.8	Avg	3.44
Comp. "B" -	From	3.40	To	4.0	Avg	3.63
Comp. "C" -	From	3.10	To	3.7	Avg	3.39
Comp. "D" -	From	3.30	To	4.0	Avg	3.65

ADDITIVE

Feed Location Solenoid Valves

Rate 4.43 #/Min. Total 177 # For 118.5 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 64 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	19	24.7				
	Comp. "B"	16.5	21.4				
	Comp. "C"	19.5	25.3				
	Comp. "D"	22	28.6				
	Total	77	100.0		38.1	0.85	2.43
SHAKEDOWN -	Comp. "A"	12	14				
	Comp. "B"	20.5	23.8				
	Comp. "C"	28	32.5				
	Comp. "D"	25.5	29.7				
	Total	86	100.0		35.0	0.72	3.43
DEFLATION - TOTAL					26.6	0.62	6.05

REMARKS

TEST NO.	M-18	FLOW (ACFM)	10,250	TEMP (°F)	350
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	3.44
ADDITIVE	$CA(OH)_2$	AVG SO_2 REMOVAL (%)	22.6	UTILIZATION (%)	6.6
CYCLE TIME	ON 60 OFF 20	DATE	June 10, 1969	OVERALL TIME	1050-1448

TEMPERATURES (°F)	Inlet Duct	350	Manifold	330
	Upper Fabric	321	Lower Fabric	305
	Outlet Duct	296		

FLOWS (ACFM)	Total House	10,250	Deflation	3,600
	Comp. "A"	1,550	Comp. "C"	3,300
	Comp. "B"	2,400	Comp. "D"	2,450

SO_2 LEVELS (PPM)	Inlet - From	800	To	1,090	Avg	942
	Outlet - From	840	To	550	Avg	729

Average Efficiency 22.6 %

PRESSURE DROPS "H_2O	House - From	4.45	To	5.35	Avg	4.88
	Comp. "A" - From	3.4	To	4.1	Avg	3.78
	Comp. "B" - From	3.4	To	4.2	Avg	3.73
	Comp. "C" - From	3.0	To	4.05	Avg	3.55
	Comp. "D" - From	3.3	To	4.4	Avg	3.92

ADDITIVE

Feed Location Solenoid Valves

Rate 4.22 #/Min. Total 338 # For 80 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 128.9 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	39.5	21.9				
	Comp. "B"	44.5	24.7				
	Comp. "C"	58.0	32.0				
	Comp. "D"	38.5	21.3				
	Total	180.5	100.0		3.43	0.56	2.33
SHAKEDOWN -	Comp. "A"	45	20.6				
	Comp. "B"	62	28.4				
	Comp. "C"	51	23.4				
	Comp. "D"	60	27.6				
	Total	218	100.0		31.5	0.30	3.62
DEFLATION - TOTAL					27.4	0.42	4.34

REMARKS

TEST NO. M-19 FLOW (ACFM) 10,000 TEMP (°F) 345
OPERATION Cyclic TYPE FEED Continuous STOICH. RATIO 2.88
ADDITIVE $CA(OH)_2$-MgO AVG SO_2 REMOVAL (%) 18.1 UTILIZATION (%) 6.3
CYCLE TIME ON 30 OFF 10 DATE June 9, 1969 OVERALL TIME 1625-1823

TEMPERATURES (°F)
Inlet Duct 345 Manifold 332
Upper Fabric 315 Lower Fabric 305
Outlet Duct 292

FLOWS (ACFM)
Total House 10,000 Deflation 3,650
Comp. "A" 1,600 Comp. "C" 3,200
Comp. "B" 2,850 Comp. "D" 1,650

SO_2 LEVELS (PPM)
Inlet - From 1,360 To 1,660 Avg 1,462
Outlet - From 1,080 To 1,380 Avg 1,197
Average Efficiency 18.1%

PRESSURE DROPS "H_2O
House - From 3.95 To 4.65 Avg 4.31
Comp. "A" - From 2.95 To 3.45 Avg 3.16
Comp. "B" - From 2.95 To 3.40 Avg 3.24
Comp. "C" - From 2.75 To 3.50 Avg 3.05
Comp. "D" - From 2.85 To 3.60 Avg 3.28

ADDITIVE
Feed Location Solenoid Valves
Rate 8.6 #/Min. Total 344 # For 40 Min.

FLYASH
Corrected Inlet Grain Loading 1.2 Grains/Ft^3
Total For Test Period 68.6 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	28	21.5				
	Comp. "B"	29	22.3				
	Comp. "C"	44	33.9				
	Comp. "D"	29	22.3				
	Total	130	100.0		27.7	0.34	2.12
SHAKEDOWN -	Comp. "A"	30	17.2				
	Comp. "B"	35	20.0				
	Comp. "C"	55	31.4				
	Comp. "D"	55	31.4				
	Total	175	100.0		25.7	0.49	2.80
DEFLATION - TOTAL					23.7	0.49	4.37

REMARKS

TEST NO. M-20 FLOW (ACFM) 10,000 TEMP (°F) 352

OPERATION Cyclic TYPE FEED Continuous STOICH. RATIO 2.18

ADDITIVE $CA(OH)_2$ MgO AVG SO_2 REMOVAL (%) 18.8 UTILIZATION (%) 7.6

CYCLE TIME ON 60 OFF 20 DATE June 9, 1969 OVERALL TIME 1220-1617

TEMPERATURES (°F)

Inlet Duct 352 Manifold 333
Upper Fabric 320 Lower Fabric 306
Outlet Duct 298

FLOWS (ACFM)

Total House 10,000 Deflation 3,650
Comp. "A" 1,750 Comp. "C" 2,850
Comp. "B" 2,500 Comp. "D" 2,250

SO_2 LEVELS (PPM)

Inlet - From 1,260 To 1,660 Avg 1,456
Outlet - From 980 To 1,360 Avg 1,181
Average Efficiency 18.8 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	4.20	5.20	4.71
Comp. "A"	3.1	4.0	3.56
Comp. "B"	3.1	4.0	3.53
Comp. "C"	2.8	4.1	3.52
Comp. "D"	3.1	4.15	3.73

ADDITIVE

Feed Location Solenoid Valves
Rate 7.4 #/Min. Total 592 # For 80 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3
Total For Test Period 125.7#

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	55	13.2				
	Comp. "B"	102	24.5				
	Comp. "C"	160	38.4				
	Comp. "D"	100	23.9				
	Total	417	100.0		28.8	0.46	2.33
SHAKEDOWN -	Comp. "A"	47	16.9				
	Comp. "B"	42	15.1				
	Comp. "C"	97	34.9				
	Comp. "D"	92	33.1				
	Total	278	100.0		25.5	0.50	3.0
DEFLATION - TOTAL					23.6	0.54	4.84

REMARKS

TEST NO.	M-21	FLOW (ACFM)	10,250	TEMP (°F)	352
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.43
ADDITIVE	Promoted $CA(OH)_2$-M_gO	AVG SO_2 REMOVAL (%)	19.1	UTILIZATION (%)	7.7
CYCLE TIME	ON 30 OFF 10	DATE	June 9, 1969	OVERALL TIME	0830-1038

TEMPERATURES (°F)				
	Inlet Duct	352	Manifold	333
	Upper Fabric	320	Lower Fabric	306
	Outlet Duct	300		

FLOWS (ACFM)				
	Total House	10,250	Deflation	3,650
	Comp. "A"	1,750	Comp. "C"	2,850
	Comp. "B"	2,500	Comp. "D"	2,250

SO_2 LEVELS (PPM)							
	Inlet -	From	1,140	To	1,500	Avg	1,262
	Outlet -	From	900	To	1,200	Avg	1,021

Average Efficiency 19.1 %

PRESSURE DROPS "H_2O							
	House -	From	4.60	To	5.20	Avg	4.79
	Comp. "A" -	From	3.10	To	4.00	Avg	3.56
	Comp. "B" -	From	3.10	To	4.00	Avg	3.53
	Comp. "C" -	From	2.80	To	4.10	Avg	3.52
	Comp. "D" -	From	3.10	To	4.15	Avg	3.73

ADDITIVE Feed Location Solenoid Valves

Rate 6.54 #/Min. Total 262 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 64.43 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	26	27.4				
	Comp. "B"	8	8.4				
	Comp. "C"	37.5	39.5				
	Comp. "D"	23.5	24.7				
	Total	95.0	100.0		25.4	0.38	2.0
SHAKEDOWN -	Comp. "A"	38	25.1				
	Comp. "B"	9	5.9				
	Comp. "C"	64	42.4				
	Comp. "D"	40	26.5				
	Total	151	100.0		24.0	0.34	2.87
DEFLATION - TOTAL					19.4	0.60	3.49

REMARKS

TEST NO.	M-22	FLOW (ACFM)	10,125	TEMP (°F)	356
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.66
ADDITIVE	Promoted $CA(OH)_2$-M_gO	AVG SO_2 REMOVAL (%)	23.2	UTILIZATION (%)	8.6
CYCLE TIME	ON 60 OFF 20	DATE	June 6, 1969	OVERALL TIME	1550-1947

TEMPERATURES (°F)	Inlet Duct	356	Manifold	332
	Upper Fabric	320	Lower Fabric	304
	Outlet Duct	301		

FLOWS (ACFM)	Total House	10,125	Deflation	3,100
	Comp. "A"	2,150	Comp. "C"	4,000
	Comp. "B"	2,400	Comp. "D"	2,250

SO_2 LEVELS (PPM)	Inlet -	From	720	To	1,120	Avg	868
	Outlet -	From	400	To	800	Avg	667

Average Efficiency 23.2 %

PRESSURE DROPS "H_2O	House -	From	4.35	To	5.05	Avg	4.70
	Comp. "A" -	From	3.0	To	3.85	Avg	3.46
	Comp. "B" -	From	3.0	To	4.05	Avg	3.56
	Comp. "C" -	From	3.0	To	4.05	Avg	3.61
	Comp. "D" -	From	3.0	To	4.15	Avg	3.68

ADDITIVE Feed Location Solenoid Valves

Rate 4.8 #/Min. Total 384 # For 80 Min.

FLYASH Corrected Inlet Grain Loading 1.2 Grains/Ft^3

Total For Test Period 138.8 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	37	33.3				
	Comp. "B"	24	21.7				
	Comp. "C"	*25	22.5				
	Comp. "D"	25	22.5				
	Total	111	100		19.1	0.24	2.66
SHAKEDOWN -	Comp. "A"	68	26.3				
	Comp. "B"	45	17.4				
	Comp. "C"	60	23.2				
	Comp. "D"	86	33.1				
	Total	259	100.0		21.5	0.30	18.72
DEFLATION - TOTAL					17.3	0.59	13.24

REMARKS * Auto. dust removal system did not remove all pretest collection "C" comp. in analysis used 25# for "C" for a total of 111#

TEST NO.	M-23	FLOW (ACFM)	15,000	TEMP (°F)	355
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.08
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	66.0	UTILIZATION (%)	61.2
CYCLE TIME	ON 45 OFF --	DATE	June 10, 1969	OVERALL TIME	1554-1639

TEMPERATURES (°F)

Inlet Duct	355	Manifold	338
Upper Fabric	329	Lower Fabric	321
Outlet Duct	316		

FLOWS (ACFM)

Total House	15,000	Deflation	5,700
Comp. "A"	3,700	Comp. "C"	4,050
Comp. "B"	4,550	Comp. "D"	4,000

SO_2 LEVELS (PPM)

Inlet	From 1,080	To 740	Avg	780
Outlet	From 960	To 200	Avg	266

Average Efficiency 66.0 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	5.75	8.85	7.3
Comp. "A"	4.10	6.95	5.5
Comp. "B"	4.20	7.20	5.7
Comp. "C"	4.0	7.1	5.5
Comp. "D"	4.0	7.2	5.6

ADDITIVE

Feed Location Solenoid Valves

Rate 5.1 #/Min. Total 223 # For 45 Min.

FLYASH

Corrected Inlet Grain Loading 1.2 Grains/Ft^3

Total For Test Period 116 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	10	16.4				
	Comp. "B"	16.5	27.0				
	Comp. "C"	20.5	33.6				
	Comp. "D"	14.0	[illegible]				
	Total	61	100.0		3.88	0.74	0.54
SHAKEDOWN -	Comp. "A"	32	19.3				
	Comp. "B"	49	29.5				
	Comp. "C"	35	21.0				
	Comp. "D"	50	30.2				
	Total	166	100.0		8.72	3.66	8.42
DEFLATION - TOTAL					6.54	3.51	8.69

REMARKS

TEST NO.	M-24	FLOW (ACFM)	7,500	TEMP (°F)	352
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.802
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	75.0	UTILIZATION (%)	93.5
CYCLE TIME	ON 65 OFF --	DATE	June 11, 1969	OVERALL TIME	0837-0942

TEMPERATURES (°F)

Inlet Duct	352	Manifold	338
Upper Fabric	317	Lower Fabric	295
Outlet Duct	285		

FLOWS (ACFM)

Total House	7,500	Deflation	3,600
Comp. "A"	*	Comp. "C"	*
Comp. "B"	*	Comp. "D"	*

SO_2 LEVELS (PPM)

Inlet -	From	720	To	930	Avg	810
Outlet -	From	160	To	560	Avg	203

Average Efficiency 75 %

PRESSURE DROPS "H_2O

House -	From	2.4	To	2.7	Avg	2.55
Comp. "A" -	From	1.55	To	1.95	Avg	1.75
Comp. "B" -	From	1.75	To	2.10	Avg	1.93
Comp. "C" -	From	1.65	To	2.00	Avg	1.83
Comp. "D" -	From	1.75	To	2.10	Avg	1.93

ADDITIVE

Feed Location Solenoid Valves

Rate 1.98 #/Min. Total 128.5 # For 65 Min.

FLYASH

Corrected Inlet Grain Loading 1.1 Grains/Ft^3

Total For Test Period 76.6 #

COLLECTION		#	%	% ASH	% SODIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	7	27.5				
	Comp. "B"	6	23.5				
	Comp. "C"	5.5	21.5				
	Comp. "D"	7	27.5				
	Total	25.5	100.0		10.32	0.88	3.49
SHAKEDOWN -	Comp. "A"	13	25.5				
	Comp. "B"	9	17.6				
	Comp. "C"	14	27.5				
	Comp. "D"	15	29.4				
	Total	51	100.0		9.30	1.30	11.07
DEFLATION - TOTAL					8.12	1.42	15.23

REMARKS

*Chart reading too low to obtain accurate flow data.

TEST NO.	M-25	FLOW (ACFM)	8000	TEMP (°F)	349
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.885
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	59.1	UTILIZATION (%)	64.1
CYCLE TIME	ON 60 OFF --	DATE	11 June '69	OVERALL TIME	1059-1206

TEMPERATURES (°F)
Inlet Duct 349
Upper Fabric 312
Outlet Duct 276
Manifold 315
Lower Fabric 286

FLOWS (ACFM) **
Total House 8000
Comp. "A" ______
Comp. "B" ______
Deflation 3700
Comp. "C" ______
Comp. "D" ______

SO_2 LEVELS (PPM)
Inlet - From 960 To 670 Avg 788.3
Outlet - From 390 To 280 Avg 324.4
Average Efficiency 59.1 %

PRESSURE DROPS "H_2O

		From	To	Avg
House	-	1.50	1.60	1.55
Comp. "A"	-	1.30	1.50	1.40
Comp. "B"	-	1.40	1.60	1.50
Comp. "C"	-	1.35	1.50	1.40
Comp. "D"	-	1.35	1.55	1.45

ADDITIVE
Feed Location Solenoid Valves
Rate 1.59 #/Min. Total 95.5 # For 60 Min.

FLYASH
Corrected Inlet Grain Loading 1.17 Grains/Ft^3
Total For Test Period 80.2 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	12.5	28.1	45.0	55.0		
	Comp. "B"	10	22.5	25.2	74.8		
	Comp. "C"	10	22.5	25.2	74.8		
	Comp. "D"	12	26.9	18.3	81.7		
	Total	44.5	100.0		71.1	Not Available	
SHAKEDOWN - *	Comp. "A"	8	25	66.8	33.2		
	Comp. "B"	5	15.6	60.4	39.6		
	Comp. "C"	7	21.9	62.7	37.3		
	Comp. "D"	12	37.5	65.9	34.1		
	Total	32	100.0		35.4	Not Available	
DEFLATION - TOTAL						Not Available	

REMARKS *Shakedown weights not accurate due to scale error - "C" appeared heavier than "D".

**Chart readings too low to obtain accurate flow data.

TEST NO.	M-26	FLOW (ACFM)	10000	TEMP (°F)	356
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.886
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	52.1	UTILIZATION (%)	59.38
CYCLE TIME	ON 75 OFF --	DATE	11 June 69	OVERALL TIME	1254-1409

TEMPERATURES (°F)
Inlet Duct 356 Manifold 334
Upper Fabric 324 Lower Fabric 304
Outlet Duct 298

FLOWS (ACFM) **
Total House 10000 Deflation 3800
Comp. "A" ____ Comp. "C" ____
Comp. "B" ____ Comp. "D" ____

SO_2 LEVELS (PPM)
Inlet - From 1000 To 1290 Avg 1158.6
Outlet - From 1030 To 430 Avg 554.9
Average Efficiency 52.1 %

PRESSURE DROPS "H_2O"

House	From 3.25	To 4.8	Avg 4.0
Comp. "A"	From 2.50	To 4.0	Avg 3.25
Comp. "B"	From 2.55	To 4.15	Avg 3.35
Comp. "C"	From 2.40	To 4.0	Avg 3.20
Comp. "D"	From 2.50	To 4.15	Avg 3.30

ADDITIVE
Feed Location Solenoid Valves
Rate 2.94 #/Min. Total 220 # For 75 Min.

FLYASH
Corrected Inlet Grain Loading 1.17 Grains/Ft^3
Total For Test Period 125.3 #

COLLECTION		#	%	% ASH	%SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	28	20	25.8	74.2		
	Comp. "B"	39.5	28.2	41.3	58.7		
	Comp. "C"	40	28.6	39.4	60.6		
	Comp. "D"	32.5	23.2	20.8	79.2		
	Total	140.0	100.0		67.1	Not Available	
SHAKEDOWN -	Comp. "A"	25	22.1	64.7	35.3		
	Comp. "B"	22	19.5	62.6	37.4		
	Comp. "C"	33	29.2	64.6	35.4		
	Comp. "D"	33	29.2	38.5	41.5		
	Total	113	100.0		37.5	Not Available	
DEFLATION - TOTAL						Not Available	

REMARKS
**Chart readings too low to obtain accurate flow data.

TEST NO.	M-27	FLOW (ACFM)	15,000	TEMP (°F)	355
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.809
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	38.06	UTILIZATION (%)	48.17
CYCLE TIME	ON 28.5 OFF --	DATE	11 June 69	OVERALL TIME	1457-1532

TEMPERATURES (°F)	Inlet Duct	355	Manifold	344
	Upper Fabric	336	Lower Fabric	322
	Outlet Duct	318		

FLOWS (ACFM)	Total House	15000	Deflation	3700
	Comp. "A"	3175	Comp. "C"	4075
	Comp. "B"	3600	Comp. "D"	3900

SO_2 LEVELS (PPM)	Inlet -	From	1230	To	1500	Avg	1378.5
	Outlet -	From	700	To	1280	Avg	853.8

Average Efficiency 38.06 %

PRESSURE DROPS "H_2O	House -	From	6.25	To	9.0	Avg	7.50
	Comp. "A" -	From	4.60	To	7.20	Avg	5.90
	Comp. "B" -	From	4.40	To	7.45	Avg	5.90
	Comp. "C" -	From	4.20	To	7.25	Avg	5.75
	Comp. "D" -	From	4.50	To	7.40	Avg	5.95

ADDITIVE

Feed Location Solenoid Valves

Rate 4.74 #/Min. Total 135 # For 28.5 Min.

FLYASH

Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 71.5 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	10	13.90	44.9	55.1		
	Comp. "B"	22	30.55	27.2	72.8		
	Comp. "C"	18	25.00	70.6	29.4		
	Comp. "D"	22	30.55	19.5	80.5		
	Total	72	100.00		61.8	Not Available	
SHAKEDOWN -	Comp. "A"	20	22.3	78.0	22.0		
	Comp. "B"	19	21.2	80.0	20.0		
	Comp. "C"	26.5	29.6	73.6	26.4		
	Comp. "D"	24	26.9	63.0	37.0		
	Total	89.5	100.0		26.9	Not Available	
DEFLATION - TOTAL						Not Available	

REMARKS

TEST NO.	M-28	FLOW (ACFM)	15,250	TEMP (°F)	305
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.607
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	38.5	UTILIZATION (%)	63.3
CYCLE TIME	ON 37 OFF --	DATE	June 11, 1969	OVERALL TIME	1742-1819

TEMPERATURES (°F)	Inlet Duct	305	Manifold	294
	Upper Fabric	288	Lower Fabric	277
	Outlet Duct	275		

FLOWS (ACFM)	Total House	15,250	Deflation	3700
	Comp. "A"	3,350	Comp. "C"	4,150
	Comp. "B"	3,700	Comp. "D"	4,000

SO_2 LEVELS (PPM)	Inlet - From	1,000	To	1,300	Avg	1,100
	Outlet - From	540	To	980	Avg	677

Average Efficiency 38.5 %

PRESSURE DROPS "H_2O	House -	From	5.85	To	8.60	Avg	7.23
	Comp. "A" -	From	4.35	To	6.70	Avg	5.53
	Comp. "B" -	From	4.20	To	6.90	Avg	5.55
	Comp. "C" -	From	3.95	To	6.80	Avg	5.38
	Comp. "D" -	From	4.05	To	7.00	Avg	5.53

ADDITIVE
Feed Location Solenoid Valves
Rate 4.4 #/Min. Total 163.1# For 37 Min.

FLYASH
Corrected Inlet Grain Loading 1.2 Grains/Ft³
Total For Test Period 95.1 #

COLLECTION		#	%	% ASH	% SODIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	8.0	17.4				
	Comp. "B"	12.5	27.2				
	Comp. "C"	16.0	34.8				
	Comp. "D"	9.5	20.6				
	Total	46	100.0		5.93	0.50	0.88
SHAKEDOWN -	Comp. "A"	21	13.5				
	Comp. "B"	45	29.1				
	Comp. "C"	47	30.3				
	Comp. "D"	42	27.1				
	Total	155	100.0		9.76	1.01	12.09
DEFLATION - TOTAL					7.74	1.17	11.37

REMARKS

TEST NO.	M-29	FLOW (ACFM)	15,000	TEMP (°F)	296
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.742
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	38.2	UTILIZATION (%)	51.4
CYCLE TIME	ON 38 OFF --	DATE	June 12, 1969	OVERALL TIME	0818-0855

TEMPERATURES (°F)

Inlet Duct 296
Upper Fabric* ______
Outlet Duct 270
Manifold * ______
Lower Fabric* ______

FLOWS (ACFM)

Total House 15,000
Comp. "A" 3,400
Comp. "B" 3,700
Deflation 3,950
Comp. "C" 4,100
Comp. "D" 4,100

SO_2 LEVELS (PPM)

Inlet - From 850 To 1060 Avg 941
Outlet - From 430 To 830 Avg 582
Average Efficiency 38.2 %

PRESSURE DROPS "H_2O

		From	To	Avg
House	-	5.85	8.85	7.35
Comp. "A"	-	4.10	6.75	5.43
Comp. "B"	-	4.15	7.0	5.58
Comp. "C"	-	4.00	7.0	5.50
Comp. "D"	-	4.15	7.1	5.58

ADDITIVE

Feed Location Solenoid Valves
Rate 4.58 #/Min. Total 172.83# For 38 Min.

FLYASH

Corrected Inlet Grain Loading 1.5 Grains/Ft^3
Total For Test Period 118.2 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	8	20.5				
	Comp. "B"	11.5	29.5				
	Comp. "C"	15	38.5				
	Comp. "D"	4.5	11.5				
	Total	39.0	100.0		4.13	0.75	0.05
SHAKEDOWN -	Comp. "A"	35	21.0				
	Comp. "B"	37	22.2				
	Comp. "C"	55	32.9				
	Comp. "D"	40	23.9				
	Total	167	100.0		6.58	1.50	7.16
DEFLATION - TOTAL					7.12	1.45	8.07

REMARKS * Not Available.

TEST NO.	M-30	FLOW (ACFM)	15,000	TEMP (°F)	352
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	.954
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	62.5	UTILIZATION (%)	65.6
CYCLE TIME	ON 50 OFF --	DATE	June 12, 1969	OVERALL TIME	0949-1039

TEMPERATURES (°F)

Inlet Duct	352	Manifold	293
* Upper Fabric	287	Lower Fabric	281
Outlet Duct	277		

FLOWS (ACFM)

Total House	15,000	Deflation	3,950
Comp. "A"	3,150	Comp. "C"	3,900
Comp. "B"	2,900	Comp. "D"	3,700

SO_2 LEVELS (PPM)

Inlet	- From	680	To	920	Avg	760
Outlet	- From	200	To	720	Avg	285

Average Efficiency 62.5 %

PRESSURE DROPS "H_2O

House	- From	6.0	To	8.4	Avg	7.2
Comp. "A"	- From	4.25	To	6.55	Avg	5.4
Comp. "B"	- From	4.30	To	6.75	Avg	5.05
Comp. "C"	- From	4.30	To	6.70	Avg	5.5
Comp. "D"	- From	4.25	To	7.0	Avg	5.63

ADDITIVE

Feed Location Solenoid Valves

Rate 4.42 #/Min. Total 220.75# For 50 Min.

FLYASH

Corrected Inlet Grain Loading 1.17 Grains/Ft^3

Total For Test Period 125.9 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	8.5	18.3				
	Comp. "B"	14	30.1				
	Comp. "C"	16.5	35.5				
	Comp. "D"	7.5	16.1				
	Total	46.5	100.0		4.67	1.46	0.72
SHAKEDOWN -	Comp. "A"	30	22.4				
	Comp. "B"	22	16.4				
	Comp. "C"	42	31.3				
	Comp. "D"	40	29.9				
	Total	134	100.0		9.39	1.51	13.24
DEFLATION - TOTAL					10.99	1.35	14.46

REMARKS *No Temp Chart

TEST NO.	M-31	FLOW (ACFM)	10000	TEMP (°F)	352
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	2.80
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	83.2	UTILIZATION (%)	29.51
CYCLE TIME	ON 60 OFF --	DATE	12 June 69	OVERALL TIME	1323-1423

TEMPERATURES (°F)

Inlet Duct	352	Manifold	334
Upper Fabric	318	Lower Fabric	297
Outlet Duct	294		

FLOWS (ACFM) **

Total House	10000	Deflation	3600
Comp. "A"		Comp. "C"	
Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)

Inlet	From 840	To 1260	Avg 978.8
Outlet	From 130	To 390	Avg 164.6

Average Efficiency 83.2 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	2.95	3.70	3.30
Comp. "A"	2.20	3.45	2.85
Comp. "B"	2.20	3.30	2.75
Comp. "C"	2.10	3.45	2.80
Comp. "D"	2.10	3.35	2.75

ADDITIVE Feed Location Solenoid Valves

Rate 7.85 #/Min. Total 471 # For 60 Min.

FLYASH Corrected Inlet Grain Loading 1.18 Grains/Ft^3

Total For Test Period 101.1 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT - *	Comp. "A"	93	36.3	9.1	90.9		
	Comp. "B"	70	27.3	7.9	92.1		
	Comp. "C"	38	14.8	16.7	83.3		
	Comp. "D"	55	21.6	8.2	91.8		
	Total	256	100.0		90.3	Not Available	
SHAKEDOWN - *	Comp. "A"	10	10.6	47.9	52.1		
	Comp. "B"	30	31.9	38.9	61.5		
	Comp. "C"	26	27.7	41.3	58.7		
	Comp. "D"	28	29.8	36.5	63.5		
	Total	94	100.0		60.3	Not Available	
DEFLATION - TOTAL						Not Available	

REMARKS *"A" fallout contains some deflation shakedown, deflation started while "A" fallout was being taken.

**Chart readings too low to obtain accurate flow data.

TEST NO.	M-32	FLOW (ACFM)	10,250	TEMP (°F)	350
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	2.44
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	85.6	UTILIZATION (%)	35.94
CYCLE TIME	ON 60 OFF --	DATE	12 June 69	OVERALL TIME	1448-1548

TEMPERATURES (°F)
Inlet Duct 350
Upper Fabric 318
Outlet Duct 295
Manifold 320
Lower Fabric 298

FLOWS (ACFM) **
Total House 10250
Comp. "A" ______
Comp. "B" ______
Deflation 3600
Comp. "C" ______
Comp. "D" ______

SO_2 LEVELS (PPM)
Inlet - From 990 To 1180 Avg 1045.5
Outlet - From 90 To 940 Avg 150.5
Average Efficiency 85.6 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	2.95	4.10	3.50
Comp. "A"	2.30	3.45	2.90
Comp. "B"	2.20	3.30	2.80
Comp. "C"	2.25	3.40	2.85
Comp. "D"	2.20	3.35	2.75

ADDITIVE
Feed Location Inlet Duct
Rate 7.4 #/Min. Total 444 # For 60 Min.

FLYASH
Corrected Inlet Grain Loading 1.18 Grains/Ft^3
Total For Test Period 103.7 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	58	31.9	8.7	91.3		
	Comp. "B"	47	25.8	9.8	90.2		
	Comp. "C"	45	24.7	10.6	89.4		
	Comp. "D"	32	17.6	10.5	89.5		
	Total	182	100.0		90.2	Not Available	
SHAKEDOWN -	Comp. "A"	24.5	21.5	33.7	66.3		
	Comp. "B"	28	24.6	37.1	62.9		
	Comp. "C"	33	28.9	37.3	62.7		
	Comp. "D"	28.5	25.0	39.2	60.8		
	Total	114.0	100.0		63.0	Not Available	
DEFLATION - TOTAL						Not Available	

REMARKS
**Chart readings too low ot obtain accurate flow data.

TEST NO.	H-1	FLOW (ACFM)	10,000	TEMP (°F)	585
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.99
ADDITIVE	$Ca(OH)_2$	AVG SO_2 REMOVAL (%)	35.6	UTILIZATION (%)	11.9
CYCLE TIME	ON 30 OFF 10	DATE	Sept. 16, 1969	OVERALL TIME	1200-1351

TEMPERATURES (°F)	Inlet Duct	585	Manifold	550
	Upper Fabric	520	Lower Fabric	475
	Outlet Duct	437		

FLOWS (ACFM)	Total House	10,000	Deflation	3,500
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)	Inlet	-	From	1430	To	1970	Avg	1657
	Outlet	-	From	850	To	1490	Avg	1067

Average Efficiency 35.6 %

PRESSURE DROPS "H_2O	House	-	From	3.65	To	4.15	Avg	3.88
	Comp. "A"	-	From	3.00	To	3.35	Avg	3.20
	Comp. "B"	-	From	3.00	To	3.35	Avg	3.14
	Comp. "C"	-	From	2.95	To	3.15	Avg	3.03
	Comp. "D"	-	From	3.20	To	3.40	Avg	3.26

ADDITIVE

Feed Location Solenoid Inlet Valves

Rate 5.05 #/Min. Total 202 # For 40 Min.

FLYASH

Corrected Inlet Grain Loading 0.944 Grains/Ft^3

Total For Test Period 53.9 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	23	26.7				
	Comp. "B"	16	18.6				
	Comp. "C"	22	25.6				
	Comp. "D"	25	29.1				
	Total	86	100.0		38.2	0.81	2.66
SHAKEDOWN -	Comp. "A"	18	26.5				
	Comp. "B"	13	19.2				
	Comp. "C"	15	22.0				
	Comp. "D"	22	32.3				
	Total	68	100.0		35.3	1.04	4.95
DEFLATION -	TOTAL				28.7	0.95	5.29

REMARKS

TEST NO.	H-2	FLOW (ACFM)	15,000	TEMP (°F)	629
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.83
ADDITIVE	$Ca(OH)_2$	AVG SO_2 REMOVAL (%)	31.8	UTILIZATION (%)	11.0
CYCLE TIME	ON 30 OFF 10	DATE	Sept. 16, 1969	OVERALL TIME	1425-1616

TEMPERATURES (°F)

Inlet Duct	629	Manifold	606
Upper Fabric	579	Lower Fabric	542
Outlet Duct	513		

FLOWS (ACFM)

Total House	15,000	Deflation	3400
Comp. "A"		Comp. "C"	
Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)

Inlet -	From	1580	To	1970	Avg	1734
Outlet -	From	990	To	1460	Avg	1183

Average Efficiency 31.8 %

PRESSURE DROPS "H_2O

House -	From	6.80	To	7.85	Avg	7.20
Comp. "A" -	From	5.60	To	6.30	Avg	6.00
Comp. "B" -	From	5.50	To	6.30	Avg	5.87
Comp. "C" -	From	5.40	To	6.30	Avg	5.82
Comp. "D" -	From	6.10	To	6.70	Avg	6.37

ADDITIVE

Feed Location Solenoid Inlet Valves

Rate 7.11 #/Min. Total 284 # For 40 Min.

FLYASH

Corrected Inlet Grain Loading 0.895 Grains/Ft^3

Total For Test Period 76.7 #

COLLECTION

		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	18	16.8				
	Comp. "B"	24	22.4				
	Comp. "C"	35	32.7				
	Comp. "D"	30	28.1				
	Total	107	100.0		40.3	1.28	3.40
SHAKEDOWN -	Comp. "A"	21	13.3				
	Comp. "B"	62	39.2				
	Comp. "C"	40	25.3				
	Comp. "D"	35	22.2				
	Total	158	100.0		35.6	1.52	5.17
DEFLATION - TOTAL					32.7	1.23	5.47

REMARKS

TEST NO.	H-4	FLOW (ACFM)	15,700	TEMP (°F)	626
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.630
ADDITIVE	Prom. Dolomite	AVG SO_2 REMOVAL (%)	48.1	UTILIZATION (%)	18.33
CYCLE TIME	ON 30 OFF 10	DATE	September 17, 1969	OVERALL TIME	120

TEMPERATURES (°F)	Inlet Duct	626	Manifold	605
	Upper Fabric	595	Lower Fabric	564
	Outlet Duct	530		

FLOWS (ACFM)	Total House	15,700	Deflation	3900
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)		From	To	Avg	
	Inlet	1280	1980	1600	
	Outlet	680	1040	832	

Average Efficiency 48.1 %

PRESSURE DROPS "H_2O		From	To	Avg
	House	7.40	8.55	7.94
	Comp. "A"	6.20	7.20	6.74
	Comp. "B"	6.00	7.05	6.48
	Comp. "C"	6.05	7.25	6.68
	Comp. "D"	6.10	7.45	6.88

ADDITIVE Feed Location Inlet Duct

Rate 10.04 #/Min. Total 402 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 0.895 Grains/Ft^3

Total For Test Period 76.7 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	27	22.1				
	Comp. "B"	32	26.2				
	Comp. "C"	40	32.8				
	Comp. "D"	23	18.9				
	Total	122	100.0		24.5	0.74	5.18
SHAKEDOWN -	Comp. "A"	53	19.7				
	Comp. "B"	67	24.9				
	Comp. "C"	82	30.5				
	Comp. "D"	67	24.9				
	Total	269	100.0		25.6	1.03	7.26
DEFLATION -	TOTAL				26.8	0.99	7.37

REMARKS

TEST NO. H-5 FLOW (ACFM) 16,000 TEMP (°F) 640

OPERATION Cyclic TYPE FEED Continuous STOICH. RATIO 3.040

ADDITIVE Dolomite AVG SO_2 REMOVAL (%) 48.6 UTILIZATION (%) 15.9

CYCLE TIME ON 30 OFF 10 DATE Sept. 17, 1969 OVERALL TIME 120

TEMPERATURES (°F)

Inlet Duct 640
Upper Fabric 612
Outlet Duct 537
Manifold 620
Lower Fabric 575

FLOWS (ACFM)

Total House 16,000
Comp. "A" ______
Comp. "B" ______
Deflation 4050
Comp. "C" ______
Comp. "D" ______

SO_2 LEVELS (PPM)

Inlet - From 1270 To 1850 Avg 1643
Outlet - From 600 To 980 Avg 846
Average Efficiency 48.6 %

PRESSURE DROPS "H_2O

House -	From	6.40	To	8.15	Avg	7.18
Comp. "A" -	From	5.5	To	6.8	Avg	6.01
Comp. "B" -	From	5.1	To	6.4	Avg	5.67
Comp. "C" -	From	5.1	To	6.9	Avg	5.80
Comp. "D" -	From	5.1	To	7.0	Avg	6.10

ADDITIVE Feed Location Inlet Duct

Rate 12.06#/Min. Total 482 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 0.883 Grains/Ft^3

Total For Test Period 75.7 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	17	24.6				
	Comp. "B"	16	23.2				
	Comp. "C"	22	31.9				
	Comp. "D"	14	20.3				
	Total	69	100.0		28.4	1.44	4.41
SHAKEDOWN -	Comp. "A"	62	26.2				
	Comp. "B"	47	19.8				
	Comp. "C"	75	31.6				
	Comp. "D"	53	22.4				
	Total	237	100.0		25.2	1.98	5.82
DEFLATION - TOTAL					24.1	1.90	5.84

REMARKS Lost Bag

TEST NO.	H-6	FLOW (ACFM)	10,500	TEMP (°F)	589
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.810
ADDITIVE	Dolomite	AVG SO_2 REMOVAL (%)	32.5	UTILIZATION (%)	11.6
CYCLE TIME	ON 30 OFF 10	DATE	Sept. 18, 1969	OVERALL TIME	120

TEMPERATURES (°F)	Inlet Duct	589	Manifold	565
	Upper Fabric	521	Lower Fabric	470
	Outlet Duct	438		

FLOWS (ACFM)	Total House	10,500	Deflation	3600
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)	Inlet - From	960	To	1240	Avg	1085
	Outlet - From	560	To	860	Avg	732
	Average Efficiency	32.5 %				

PRESSURE DROPS "H_2O	House - From	3.70	To	4.25	Avg	3.98
	Comp. "A" - From	2.90	To	3.15	Avg	3.00
	Comp. "B" - From	3.10	To	3.40	Avg	3.19
	Comp. "C" - From	2.80	To	3.25	Avg	3.01
	Comp. "D" - From	3.2	To	3.5	Avg	3.38

ADDITIVE Feed Location Solenoid Inlet Valves

Rate 5.04 #/Min. Total 202 # For 40 Min.

FLYASH Corrected Inlet Grain Loading 0.931 Grains/Ft^3

Total For Test Period 55.8 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	16	14.3				
	Comp. "B"	14	12.5				
	Comp. "C"	35	31.3				
	Comp. "D"	47	41.9				
	Total	112	100.0		24.4	1.00	2.54
SHAKEDOWN -	Comp. "A"	16	15.7				
	Comp. "B"	24	23.5				
	Comp. "C"	35	34.3				
	Comp. "D"	27	26.5				
	Total	102	100.0		23.1	0.87	3.94
DEFLATION - TOTAL					19.6	0.78	3.74

REMARKS

TEST NO.	H-7	FLOW (ACFM)	10,800	TEMP (°F)	599
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	2.690
ADDITIVE	Dolomite	AVG SO_2 REMOVAL (%)	42.4	UTILIZATION (%)	15.8
CYCLE TIME	ON 60 OFF 20	DATE	September 18, 1969	OVERALL TIME	220

TEMPERATURES (°F)	Inlet Duct	599	Manifold	554
	Upper Fabric	527	Lower Fabric	477
	Outlet Duct	435		

FLOWS (ACFM)	Total House	10,800	Deflation	3700
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)	Inlet - From 890	To 1240	Avg 1087	
	Outlet - From 470	To 730	Avg 626	
	Average Efficiency 42.4 %			

PRESSURE DROPS "H_2O		From	To	Avg
	House	3.30	4.40	3.71
	Comp. "A"			
	Comp. "B"	2.80	3.40	
	Comp. "C"	2.70	3.25	3.08
	Comp. "D"			2.95

ADDITIVE Feed Location Inlet Duct

Rate 4.93 #/Min. Total 394 # For 80 Min.

FLYASH Corrected Inlet Grain Loading 1.01 Grains/Ft^3

Total For Test Period 118.3 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	32	16.2				
	Comp. "B"	44	22.2				
	Comp. "C"	28	14.1				
	Comp. "D"	94	47.5				
	Total	198	100.0		22.6	0.92	3.25
SHAKEDOWN -	Comp. "A"	29	19.7				
	Comp. "B"	29	19.7				
	Comp. "C"	37	25.2				
	Comp. "D"	52	35.4				
	Total	147	100.0		23.1	0.86	4.15
DEFLATION - TOTAL					21.1	0.77	4.38

REMARKS

TEST NO.	H-8	FLOW (ACFM)	8,500	TEMP (°F)	542
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.860
ADDITIVE	NaH CO$_3$	AVG SO$_2$ REMOVAL (%)	97.5	UTILIZATION (%)	52.2
CYCLE TIME	ON 60 OFF --	DATE	Sept. 24, 1969	OVERALL TIME	1006-1106

TEMPERATURES (°F)

Inlet Duct 542
Upper Fabric 480
Outlet Duct 412
Manifold 490
Lower Fabric 435

FLOWS (ACFM)

Total House 8,700
Comp. "A" ____
Comp. "B" ____
Deflation 3,100
Comp. "C" ____
Comp. "D" ____

SO$_2$ LEVELS (PPM)

	From	To	Avg
Inlet -	1,370	1,760	1,489
Outlet -	20	100	39

Average Efficiency 97.5 %

PRESSURE DROPS "H$_2$O

	From	To	Avg
House -	1.35	1.65	
Comp. "A" -	--	--	Off Stream
Comp. "B" -	0.65	0.9	.78
Comp. "C" -	0.45	0.8	.63
Comp. "D" -	0.65	1.0	8.3

ADDITIVE

Feed Location Inlet Duct
Rate 5.42 #/Min. Total 336.25 # For 62 Min.

FLYASH

Corrected Inlet Grain Loading 0.95 Grains/Ft^3
Total For Test Period 69.4 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO$_3$)	%(SO$_4$)
FALLOUT -	Comp. "A"	Off Stream					
	Comp. "B"	2.5	9.8		7.9		
	Comp. "C"	10.5	41.2		74.0		
	Comp. "D"	12.5	49.0		48.9		
	Total	25.5			55.2	0.57	12.54
SHAKEDOWN -	Comp. "A"	Off Stream					
	Comp. "B"	0	0		71.7		
	Comp. "C"	12	33.3		63.7		
	Comp. "D"	24	66.7		62.0		
	Total	36	100		62.6	0.60	20.96
DEFLATION - TOTAL					44.4	0.90	20.15

REMARKS

First test on new bags.
B hopper plugged - no sample available.

TEST NO.	H-9	FLOW (ACFM)	8,700	TEMP (°F)	532
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.970
ADDITIVE	NaH CO_3	AVG SO_2 REMOVAL (%)	98.4	UTILIZATION (%)	49.8
CYCLE TIME	ON 60 OFF --	DATE	Sept. 24, 1969	OVERALL TIME	1206-1306

TEMPERATURES (°F)

Inlet Duct 532
Upper Fabric 490
Outlet Duct 395
Manifold 510
Lower Fabric 433

FLOWS (ACFM)

Total House 8,700
Comp. "A"
Comp. "B"
Deflation 2950
Comp. "C"
Comp. "D"

SO_2 LEVELS (PPM)

Inlet - From 1,360	To 1,660	Avg 1,525
Outlet - From 10	To 70	Avg 24

Average Efficiency 98.4 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	1.50	1.70	1.60
Comp. "A"	--	--	---
Comp. "B"	.85	1.05	.95
Comp. "C"	.80	1.05	.92
Comp. "D"	.90	1.15	.98

ADDITIVE

Feed Location Solenoid Inlet Valves
Rate 4.94 #/Min. Total 350.5 # For 71 Min.

FLYASH

Corrected Inlet Grain Loading .96 Grains/Ft^3
Total For Test Period 71.7 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	Off Stream					
	Comp. "B"	16.5	19.2		87.7		
	Comp. "C"	41.5	48.3		82.7		
	Comp. "D"	28.0	32.5		83.2		
	Total	86.0	100		83.8	0.68	14.44
SHAKEDOWN -	Comp. "A"	Off Stream					
	Comp. "B"	20	22.5		---		
	Comp. "C"	34	38.2		79.0		
	Comp. "D"	35	39.3		76.1		
	Total	89	100		77.5	0.98	19.33
DEFLATION - TOTAL					64.5	0.95	22.56

REMARKS

TEST NO. H-10 FLOW (ACFM) 8,300 TEMP (°F) 496
OPERATION Parallel TYPE FEED Continuous STOICH. RATIO 1.35
ADDITIVE $NaHCO_3$ AVG SO_2 REMOVAL (%) 94.6 UTILIZATION (%) 70
CYCLE TIME ON 60 OFF -- DATE September 24, '69 OVERALL TIME 1438-1538

TEMPERATURES (°F)
Inlet Duct 496
Upper Fabric 430
Outlet Duct 358
Manifold 432
Lower Fabric 396

FLOWS (ACFM)
Total House 8,300
Comp. "A" ____
Comp. "B" ____
Deflation 2700
Comp. "C" ____
Comp. "D" ____

SO_2 LEVELS (PPM)
Inlet - From 1120 To 1870 Avg 1289
Outlet - From 40 To 120 Avg 70
Average Efficiency 94.6 %

PRESSURE DROPS "H_2O

		From	To	Avg
House	-	1.15	1.35	1.25
Comp. "A"	-	--	--	--
Comp. "B"	-	.60	.85	.72
Comp. "C"	-	.70	.85	.73
Comp. "D"	-	.65	.90	.78

ADDITIVE Feed Location Inlet Duct
Rate 3.48 #/Min. Total 237 # For 68 Min.

FLYASH Corrected Inlet Grain Loading .90 Grains/Ft^3
Total For Test Period 64.2 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	Off Stream					
	Comp. "B"	5.0	23.3		84.1		
	Comp. "C"	4.5	20.9		79.5		
	Comp. "D"	12.0	55 °		78.6		
	Total	21.5	100		80.1	0.66	20.01
SHAKEDOWN -	Comp. "A"	Off Stream					
	Comp. "B"	6	25.0		68.2		
	Comp. "C"	7	29.2		68.4		
	Comp. "D"	11	45.8		71.5		
	Total	24	100		69.8	0.76	27.45
DEFLATION - TOTAL					66.1	0.86	27.48

REMARKS

TEST NO.	H-11	FLOW (ACFM)	8,300	TEMP (°F)	512
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	1.129
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	96.7	UTILIZATION (%)	85.2
CYCLE TIME	ON 60 OFF --	DATE	Sept. 24, 1969	OVERALL TIME	1651-1751

TEMPERATURES (°F)

Inlet Duct	512	Manifold	455
Upper Fabric		Lower Fabric	396
Outlet Duct	358		

FLOWS (ACFM)

Total House	8,300	Deflation	3750
Comp. "A"		Comp. "C"	
Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)

Inlet -	From	1,320	To	1,690	Avg	1,492
Outlet -	From	20	To	80	Avg	58

Average Efficiency 96.2 %

PRESSURE DROPS "H_2O

House -	From	1.35	To	1.50	Avg	1.43
Comp. "A" -	From	--	To	--	Avg	--
Comp. "B" -	From	.80	To	.95	Avg	.87
Comp. "C" -	From	.70	To	.90	Avg	.78
Comp. "D" -	From	.80	To	1.05	Avg	.93

ADDITIVE Feed Location Inlet Duct

* Rate 4.745#/Min. Total 217 # For 45.75Min.

FLYASH Corrected Inlet Grain Loading .98 Grains/Ft^3

Total For Test Period 69.8 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	Off Stream					
	Comp. "B"	6.0	34.3		66.6		
	Comp. "C"	4.5	25.7		60.2		
	Comp. "D"	7.0	40.0		62.9		
	Total	17.5	100.0		61.8	0.92	21.28
SHAKEDOWN -	Comp. "A"	Off Stream					
	Comp. "B"	15	34.1		58.7		
	Comp. "C"	15	34.1		57.4		
	Comp. "D"	14	31.8		57.2		
	Total	44	100.0		57.8	0.38	27.25
DEFLATION - TOTAL					57.1	0.50	27.60

REMARKS *Feeder plugged 14 Min. 15 Sec. starting at 12 Min. 30 Sec. from start of test. All data extrapolated for 60 min. test period.

TEST NO.	H-12	FLOW (ACFM)	12,300	TEMP (°F)	604
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	0.995
ADDITIVE	Nahcolite	AVG SO_2 REMOVAL (%)	93.6	UTILIZATION (%)	94.0
CYCLE TIME	ON 49 OFF --	DATE	Sept. 24, 1969	OVERALL TIME	1815-1904

TEMPERATURES (°F)

Inlet Duct	604	Manifold	560
Upper Fabric	551	Lower Fabric	494
Outlet Duct	465		

FLOWS (ACFM)

Total House	12,300	Deflation	4550
Comp. "A"		Comp. "C"	
Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)

Inlet - From 1,680	To 2,000	Avg 1,827
Outlet - From 70	To 480	Avg 117

Average Efficiency 93.6 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	2.75	4.80	3.72
Comp. "A"	--	--	Off Stream
Comp. "B"	1.75	3.90	3.06
Comp. "C"	1.75	3.90	3.06
Comp. "D"	1.60	3.95	3.06

ADDITIVE

Feed Location Inlet Duct

* Rate 6.94 #/Min. Total 333 # For 48 Min.

FLYASH

Corrected Inlet Grain Loading .90 Grains/Ft^3

Total For Test Period 77.2 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	Off stream					
	Comp. "B"	56.0	55.2				
	Comp. "C"	33.0	32.5				
	Comp. "D"	12.5	12.3				
	Total	101.5	100.0		13.10	1.02	8.81
SHAKEDOWN -	Comp. "A"	Off stream					
	Comp. "B"	97	38.6				
	Comp. "C"	82	32.7				
	Comp. "D"	72	28.7				
	Total	251	100.0		15.22	0.79	23.20
DEFLATION - TOTAL					14.07	0.77	22.12

REMARKS

*Data recorded at test site gave total feed of 233 #. Since additive weighed in 50# sacks, it is believed to be an error in recording and the figure should be 333 #.

TEST NO.	H-13	FLOW (ACFM)	12,300	TEMP (°F)	606
OPERATION	Parallel	TYPE FEED	Continuous	STOICH. RATIO	0.970
ADDITIVE	$NaHCO_3$	AVG SO_2 REMOVAL (%)	85.0	UTILIZATION (%)	87.6
CYCLE TIME	ON 45 OFF --	DATE	Sept. 24, 1969	OVERALL TIME	1922-2007

TEMPERATURES (°F)

Inlet Duct 606

Upper Fabric 547

Outlet Duct 477

Manifold 558

Lower Fabric 513

FLOWS (ACFM)

Total House 12,300

Comp. "A" ______

Comp. "B" ______

Deflation 3150

Comp. "C" ______

Comp. "D" ______

SO_2 LEVELS (PPM)

Inlet -	From	1,700	To	2,000	Avg	1,841
Outlet -	From	130	To	560	Avg	276

Average Efficiency 85.0%

PRESSURE DROPS "H_2O

House -	From	2.25	To	3.55	Avg	2.96
Comp. "A" -	From	--	To	--	Avg	Off Stream
Comp. "B" -	From	1.20	To	2.60	Avg	2.0
Comp. "C" -	From	1.20	To	2.60	Avg	1.96
Comp. "D" -	From	1.25	To	2.70	Avg	2.05

ADDITIVE

Feed Location Inlet Duct

Rate 4.74 #/Min. Total 223 # For 47 Min.

FLYASH

Corrected Inlet Grain Loading .90 Grains/Ft^3

Total For Test Period 70.8 #

COLLECTION		#	%	% ASH	% SOLUBLES	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	Off stream					
	Comp. "B"	23.5	40.5		51.7		
	Comp. "C"	22.0	37.9		48.1		
	Comp. "D"	12.5	21.6		62.1		
	Total	58.0			52.6	0.93	12.81
SHAKEDOWN -	Comp. "A"	Off stream					
	Comp. "B"	45	34.6		55.0		
	Comp. "C"	50	38.5		55.7		
	Comp. "D"	35	26.9		52.2		
	Total	130	100.0		54.5	0.39	21.14
DEFLATION - TOTAL					51.3	0.43	22.61

REMARKS

TEST NO.	H-14.	FLOW (ACFM)	11,100	TEMP (°F)	586
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.902
ADDITIVE	Dolomite	AVG SO_2 REMOVAL (%)	18.55	UTILIZATION (%)	20.6
CYCLE TIME	ON 30 OFF 10	DATE	Sept. 25, 1969	OVERALL TIME	0941-1126

TEMPERATURES (°F)	Inlet Duct	586	Manifold	575
	Upper Fabric	550	Lower Fabric	500
	Outlet Duct	495		

FLOWS (ACFM)	Total House	11,100	Deflation	3,500
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)	Inlet	-	From	1,480	To	1,920	Avg	1,634
	Outlet	-	From	1,200	To	1,540	Avg	1,331

Average Efficiency 18.55 %

PRESSURE DROPS "H_2O	House	-	From	2.50	To	2.90	Avg	2.73
	Comp. "A"	-	From	1.3	To	1.85	Avg	1.58
	Comp. "B"	-	From	1.4	To	2.0	Avg	1.74
	Comp. "C"	-	From	1.4	To	1.85	Avg	1.64
	Comp. "D"	-	From	1.6	To	2.0	Avg	1.83

ADDITIVE Feed Location Inlet Duct

Rate 2.475 #/Min. Total 99 # For 40 Min.

FLYASH Corrected Inlet Grain Loading .92 Grains/Ft^3

Total For Test Period 58.35 #

COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	9.0	33.3				
	Comp. "B"	8.5	31.5				
	Comp. "C"	4.5	16.7				
	Comp. "D"	5.0	18.5				
	Total	27	100.0		14.9	0.30	5.66
SHAKEDOWN -	Comp. "A"	10	20.0				
	Comp. "B"	14	28.0				
	Comp. "C"	14	28.0				
	Comp. "D"	12	24.0				
	Total	50	100.0		22.4	0.57	6.23
DEFLATION - TOTAL					20.0	1.02	5.73

REMARKS

TEST NO.	H-15	FLOW (ACFM)	14,500	TEMP (°F)	631
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.913
ADDITIVE	Dolomite	AVG SO_2 REMOVAL (%)	21.94	UTILIZATION (%)	24.0
CYCLE TIME	ON 60 OFF 20	DATE	Sept. 25, 1969	OVERALL TIME	1133-1503

TEMPERATURES (°F)

Inlet Duct	631	Manifold	612
Upper Fabric	602	Lower Fabric	560
Outlet Duct	530		

FLOWS (ACFM)

Total House	14,500	Deflation	3,200
Comp. "A"		Comp. "C"	
Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)

	From	To	Avg
Inlet	1,780	2,000	1,773
Outlet	1,140	1,610	1,384

Average Efficiency 21.94 %

PRESSURE DROPS "H_2O

	From	To	Avg
House	4.3	5.75	4.9
Comp. "A"	2.6	4.2	3.6
Comp. "B"	2.8	4.5	3.6
Comp. "C"	2.2	4.4	3.2
Comp. "D"	2.5	4.6	3.7

ADDITIVE

Feed Location Inlet Duct

Rate 3.81#/Min. Total 305 # For 80 Min.

FLYASH

Corrected Inlet Grain Loading .89 Grains/Ft^3

Total For Test Period 147.3#

COLLECTION

		#	%	% ASH	% CALCIUM	$\%(SO_3)$	$\%(SO_4)$
FALLOUT -	Comp. "A"	3.0	06.6				
	Comp. "B"	3.5	07.7				
	Comp. "C"	25.0	54.9				
	Comp. "D"	14.0	30.8				
	Total	45.5	100.0		21.3	0.90	4.76
SHAKEDOWN -	Comp. "A"	51.5	18.5				
	Comp. "B"	82.0	29.4				
	Comp. "C"	70.0	25.1				
	Comp. "D"	75.0	27.0				
	Total	278.5	100.0		22.4	1.23	5.36
DEFLATION - TOTAL					22.4	1.33	5.57

REMARKS

TEST NO.	H-16	FLOW (ACFM)	15,000	TEMP (°F)	629
OPERATION	Cyclic	TYPE FEED	Continuous	STOICH. RATIO	0.781
ADDITIVE	Dolomite	AVG SO_2 REMOVAL (%)	17.4	UTILIZATION (%)	22.2
CYCLE TIME	ON 30 OFF 10	DATE	Sept. 26, 1969	OVERALL TIME	1003-1153

TEMPERATURES (°F)	Inlet Duct	629	Manifold	610
	Upper Fabric	600	Lower Fabric	537
	Outlet Duct	525		

FLOWS (ACFM)	Total House	15,000	Deflation	4,100
	Comp. "A"		Comp. "C"	
	Comp. "B"		Comp. "D"	

SO_2 LEVELS (PPM)	Inlet -	From	1,490	To	1,960	Avg	1,704
	Outlet -	From	1,200	To	1,560	Avg	1,408

Average Efficiency 17.4 %

PRESSURE DROPS "H_2O	House -	From	4.3	To	5.2	Avg	4.73
	Comp. "A" -	From	2.8	To	3.8	Avg	3.33
	Comp. "B" -	From	2.9	To	3.8	Avg	3.37
	Comp. "C" -	From	2.4	To	3.6	Avg	3.08
	Comp. "D" -	From	2.4	To	3.9	Avg	3.30

ADDITIVE Feed Location Inlet Duct

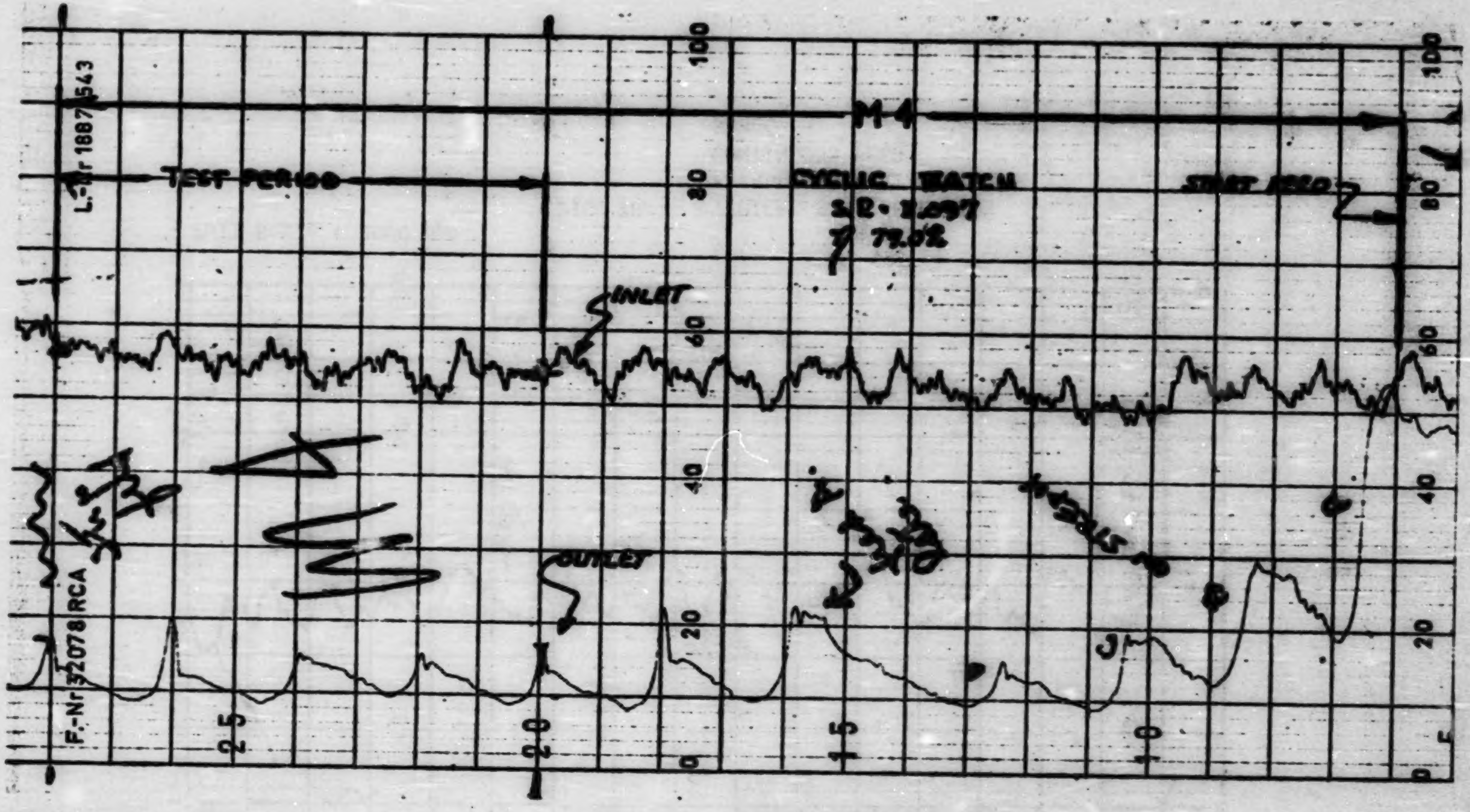
Rate 3.61 #/Min. Total 144 # For 40 Min.

FLYASH Corrected Inlet Grain Loading .89 Grains/Ft^3

Total For Test Period 76.4 #

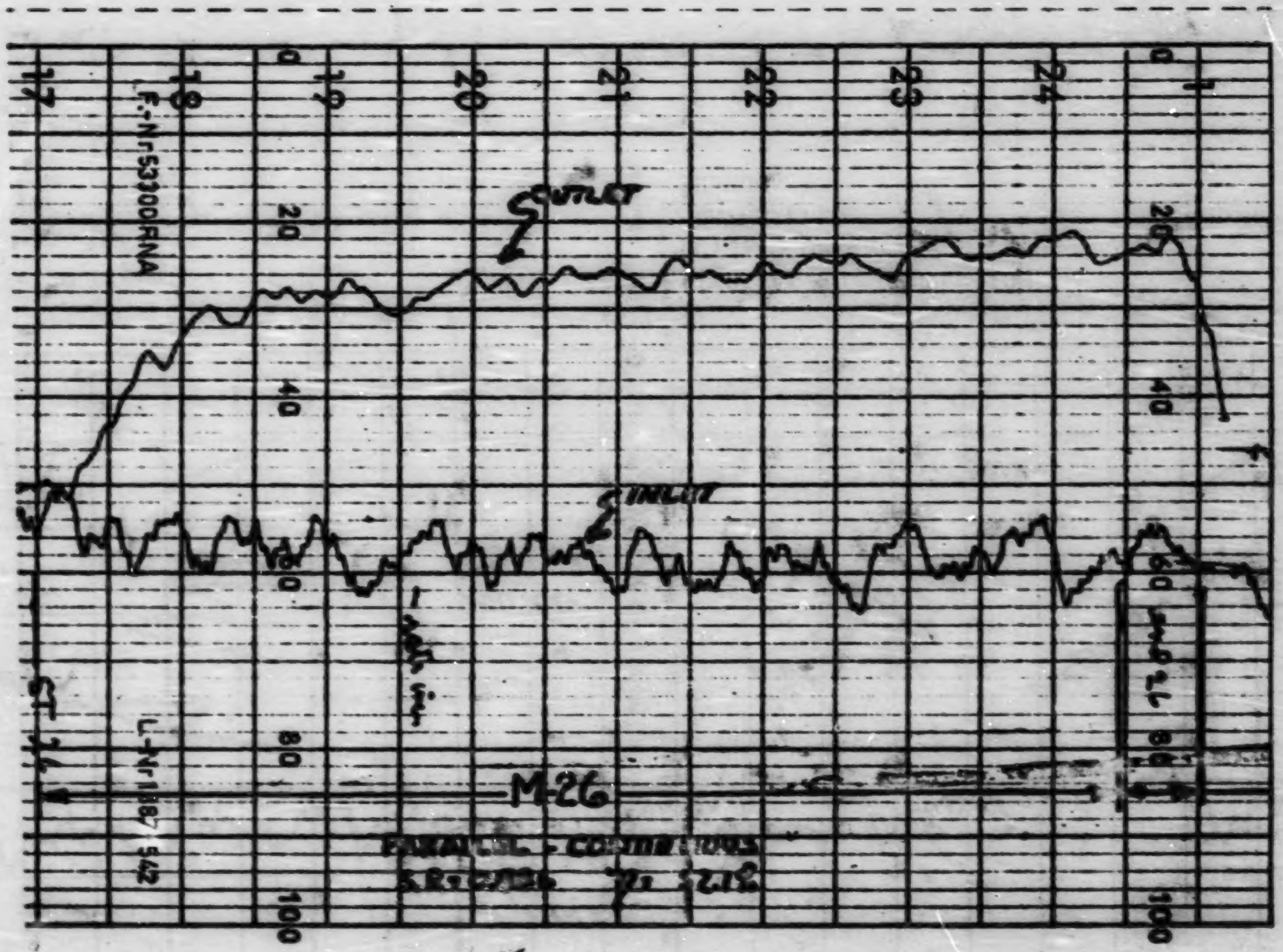
COLLECTION		#	%	% ASH	% CALCIUM	%(SO_3)	%(SO_4)
FALLOUT -	Comp. "A"	9.0	25.0				
	Comp. "B"	7.5	20.8				
	Comp. "C"	13.0	36.1				
	Comp. "D"	6.5	18.1				
	Total	36.0	100.0		19.4	0.93	3.26
SHAKEDOWN -	Comp. "A"	21	22.1				
	Comp. "B"	12	12.6				
	Comp. "C"	30	31.6				
	Comp. "D"	32	33.7				
	Total	95	100.0		19.0	1.10	5.94
DEFLATION - TOTAL							

REMARKS



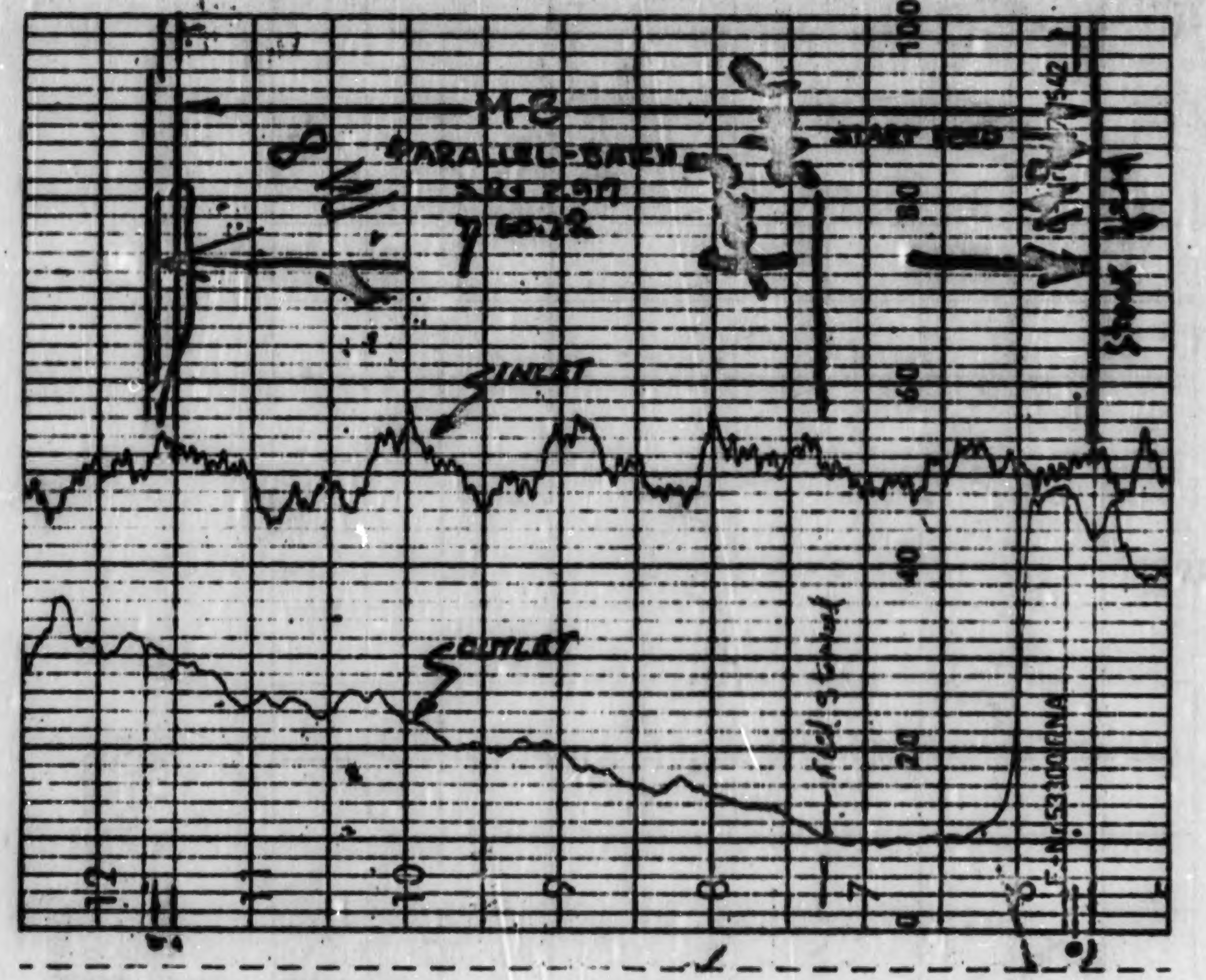
Full Scale = 2000 ppm

FIG. 27 - TYPICAL SO_2 CONVERSION
CYCLIC OPERATION
BATCH FEED
$NaHCO_3$



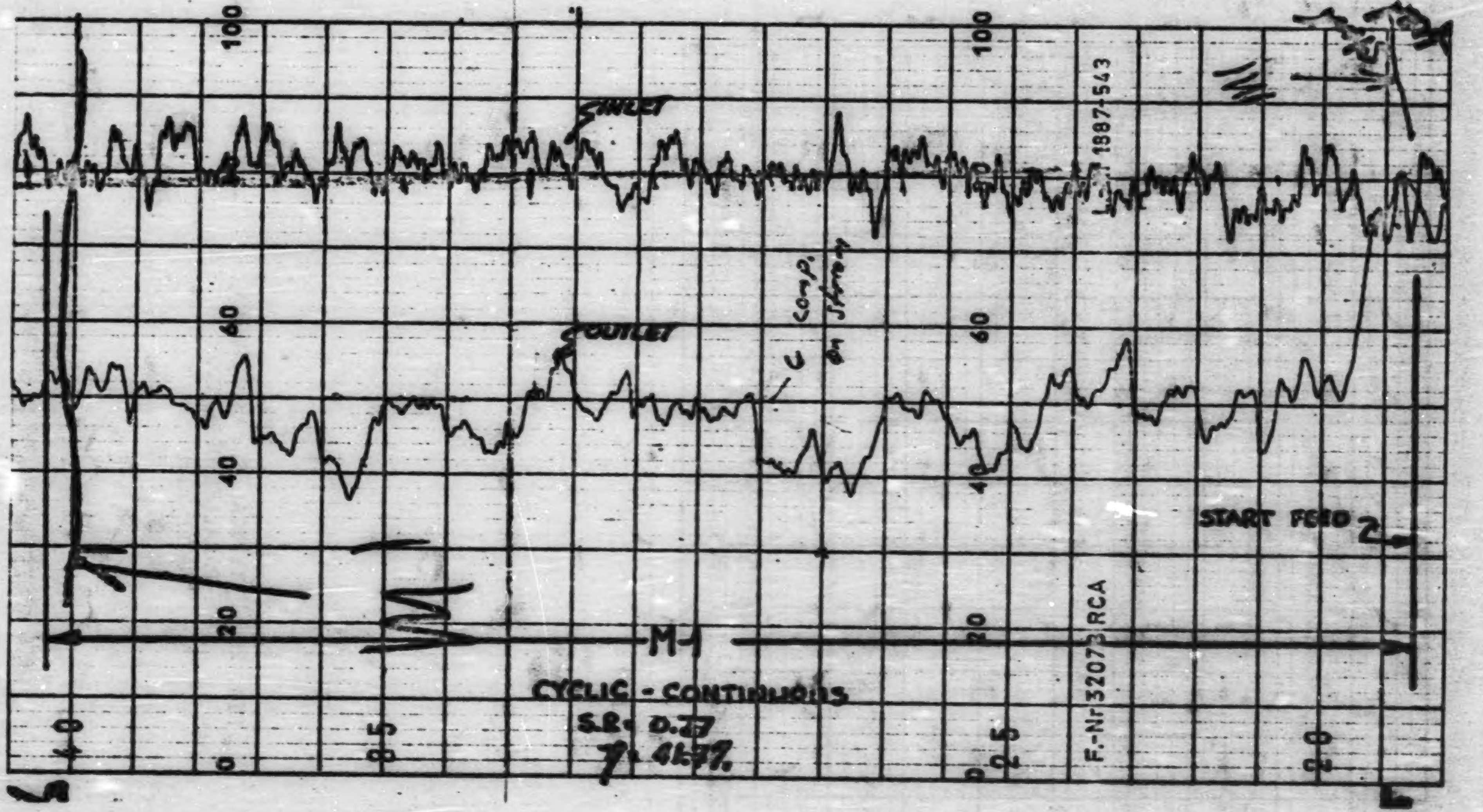
Full Scale = 2000 ppm

FIG. 28 - TYPICAL SO_2 CONVERSION
PARALLEL OPERATION
CONTINUOUS FEED
$NaHCO_3$



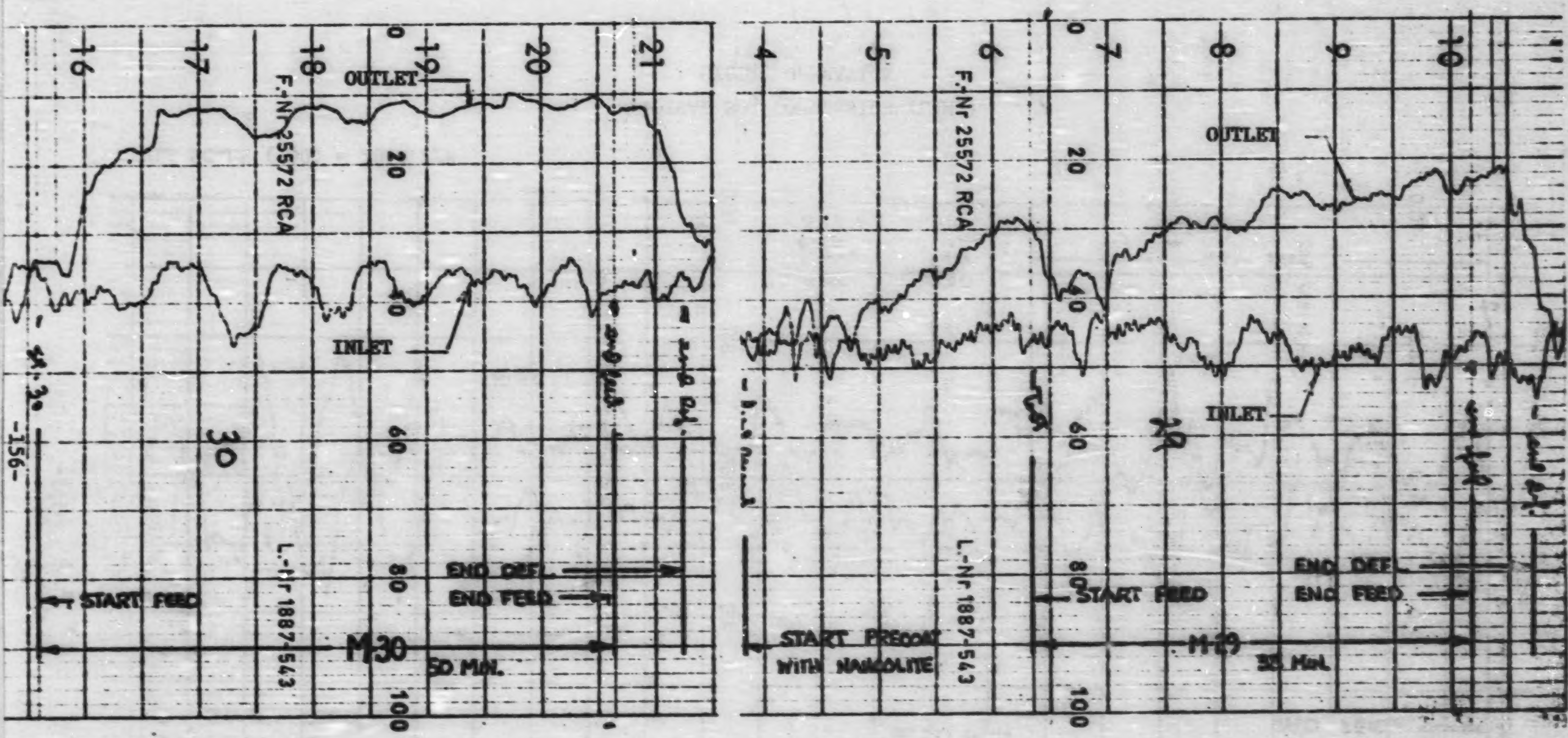
Full Scale = 2000 ppm

FIG. 29 - TYPICAL SO_2 CONVERSION
PARALLEL OPERATION
BATCH FEED
$NaHCO_3$



Full Scale = 2000 ppm

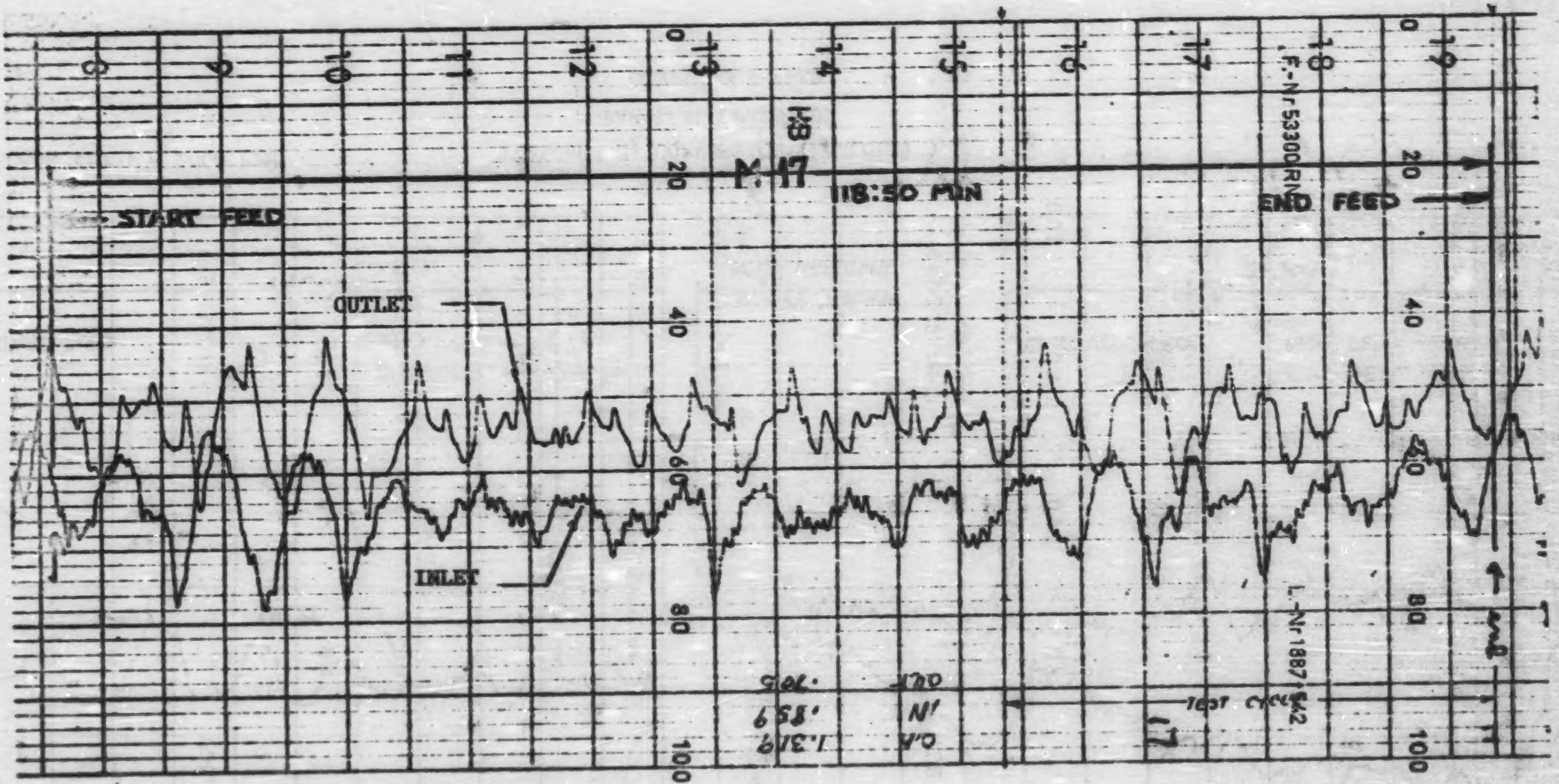
FIG. 30 - TYPICAL SO_2 CONVERSION
CYCLIC OPERATION
CONTINUOUS FEED
$NaHCO_3$



FULL SCALE (100) - 2000 PPM

TYPICAL SO_2 CONVERSION (NAHCOLITE)
PARALLEL OPERATION
CONTINUOUS FEED

FIG. 31

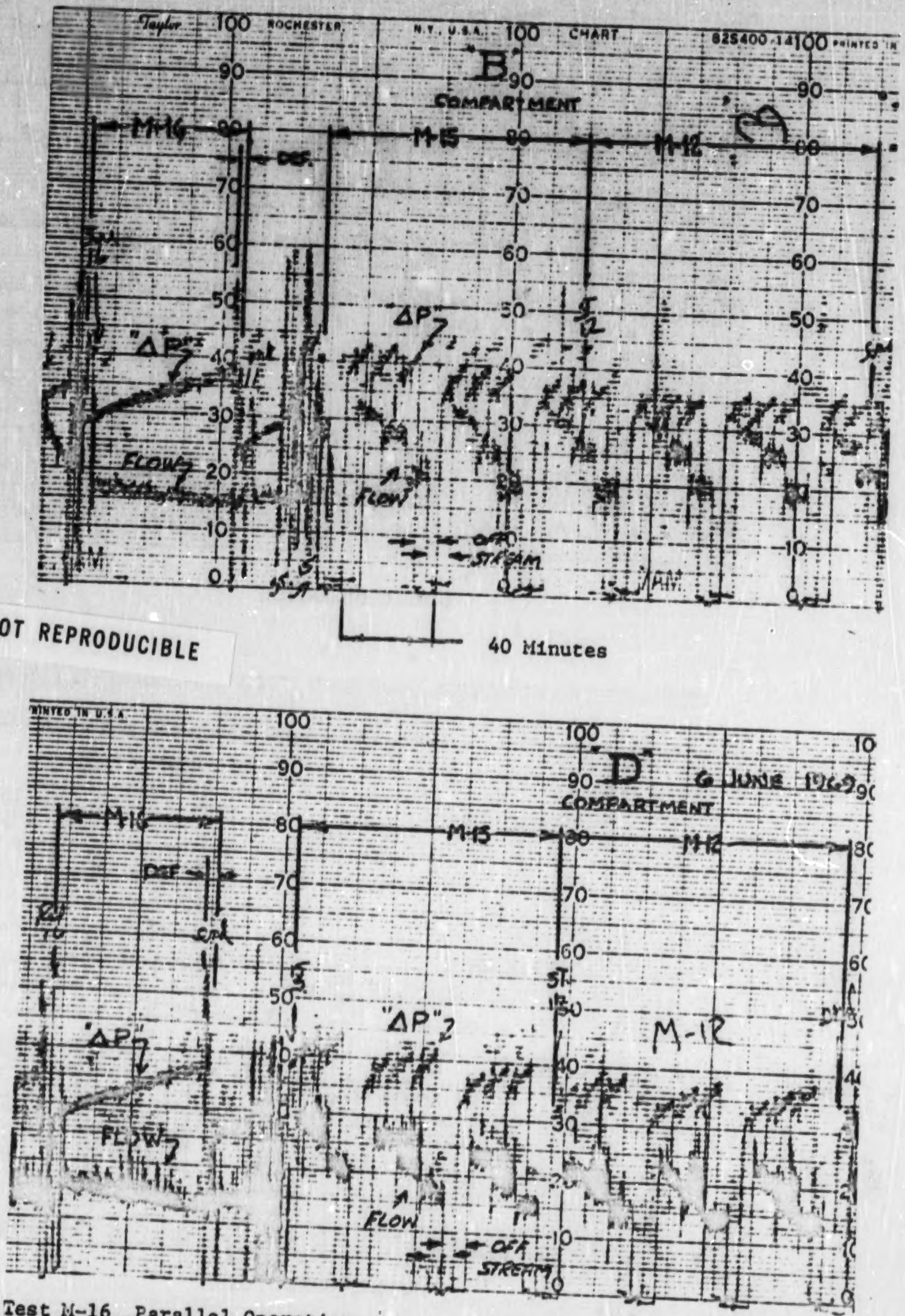


FULL SCALE (100) - 2000 PPM

TYPICAL SO_2 CONVERSION (LIME)
CYCLIC OPERATION

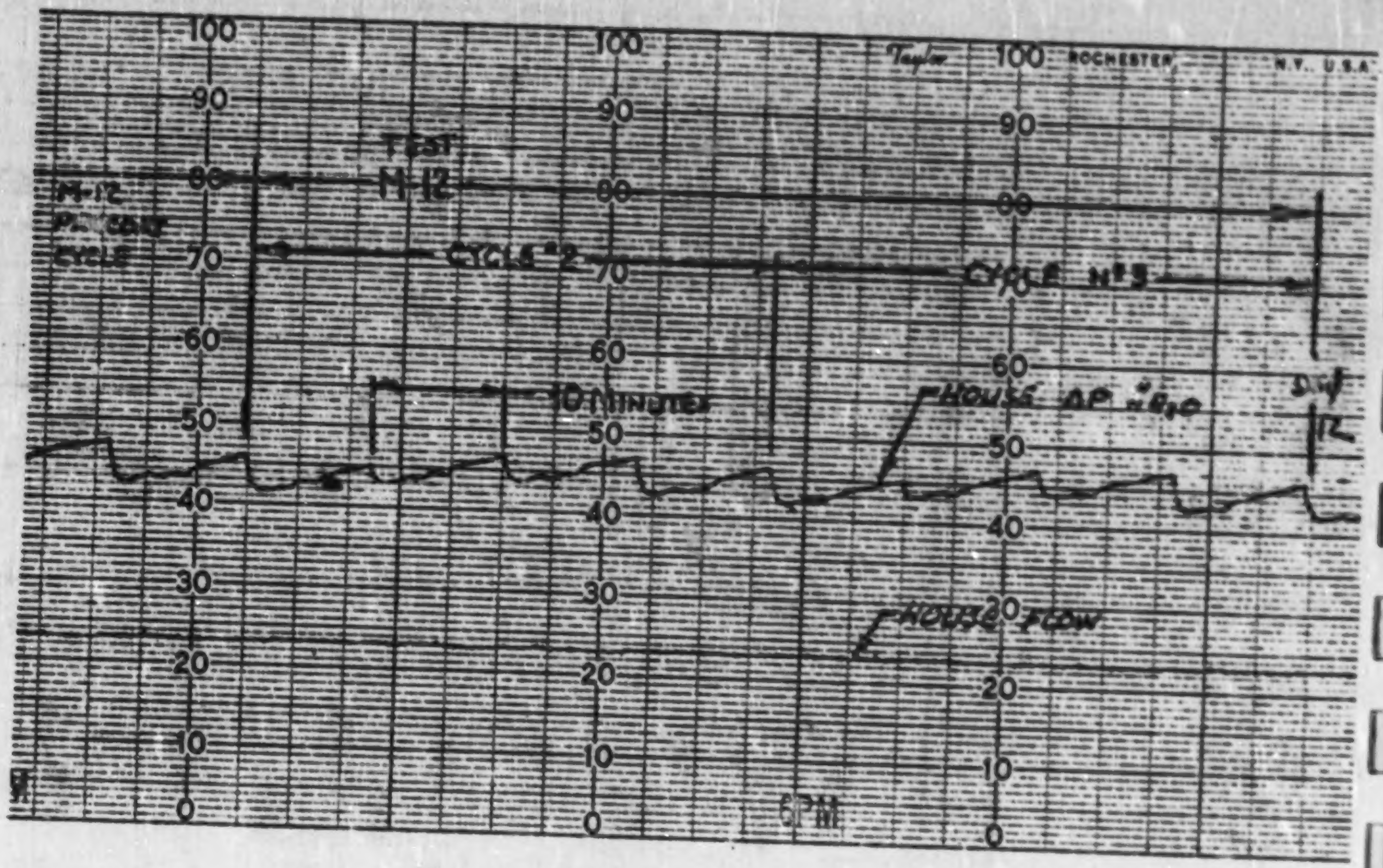
FIG. 32

NOT REPRODUCIBLE

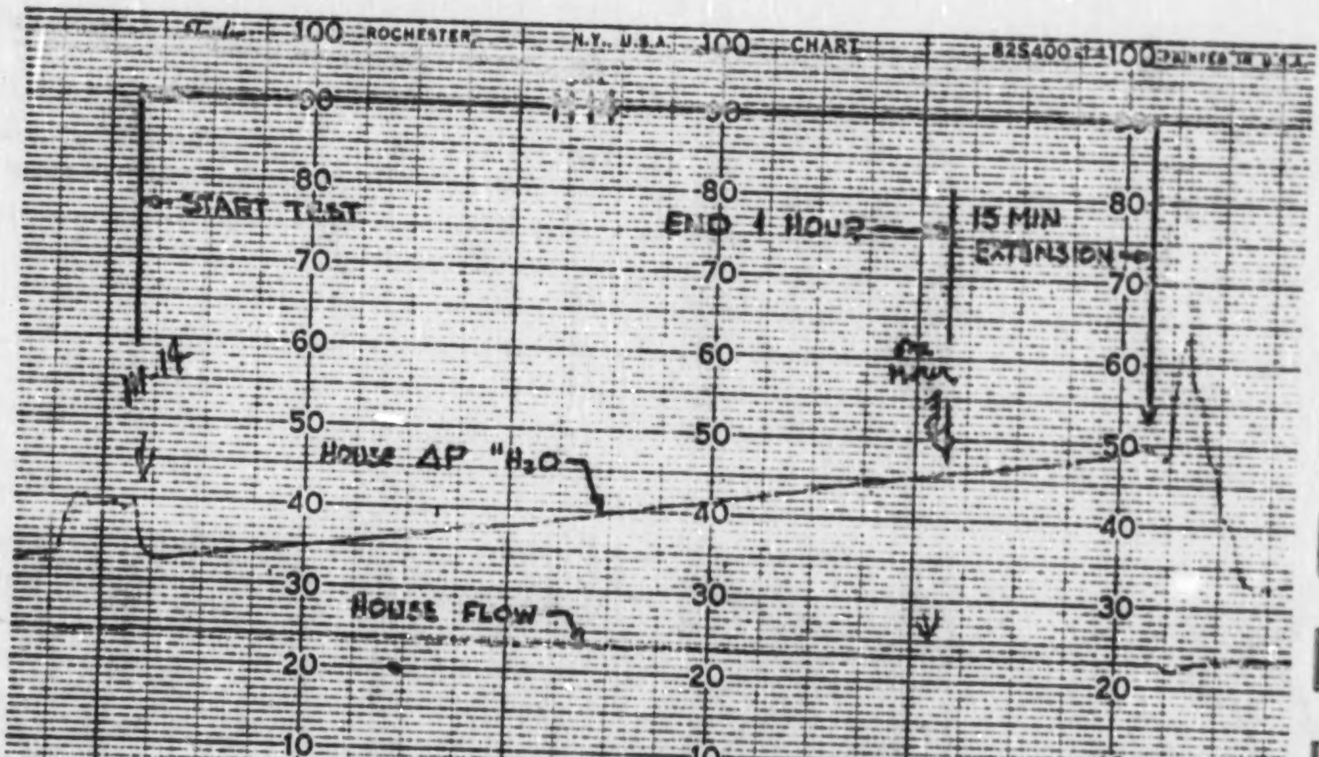


Test M-16 Parallel Operation
Tests M-15 & M-12 Cyclic Operation
(10 Min. Between Compartment Stepping)

FIG. 33
Typical Compartment Flow and ΔP Monitoring Charts



CYCLIC OPERATION



PARALLEL OPERATION

FIG. 34 Typical House ΔP and Flow Monitoring Charts

29108 Southeast Elevation - Bag Filterhouse

Southeast Elevation - Bag Filterhouse

6-5-69 Mercer Generating Station

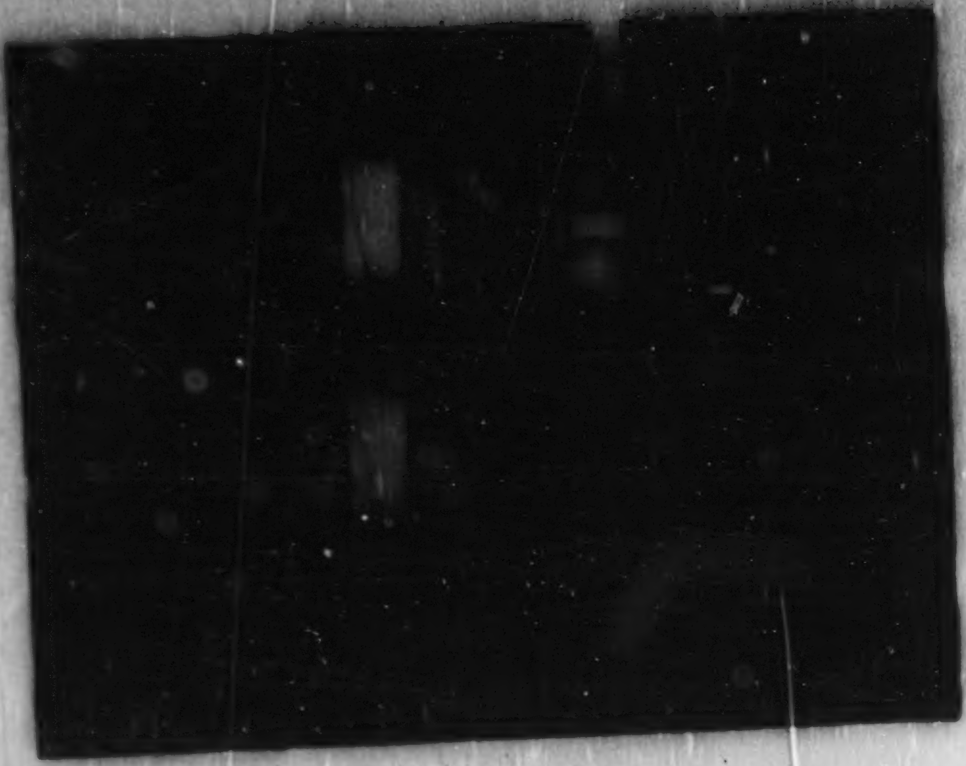
Public Service Electric and Gas Company

Photo 1

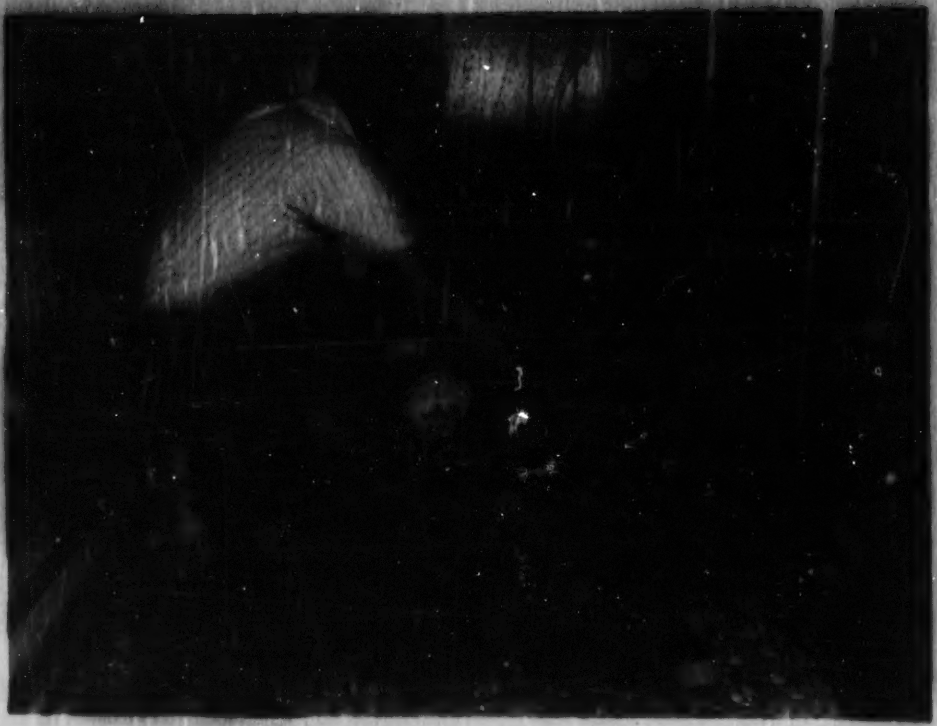
29417-4 Additive Feed System - Bag Filterhouse

9-22-69 Mercer Generating Station Public Service Electric and Gas Company

Photo 2



29417-3 Pressure and Flow Transmitters
Bag Filterhouse
9-22-69 Mercer Generating Station Public Service Electric and Gas Company
Photo 3



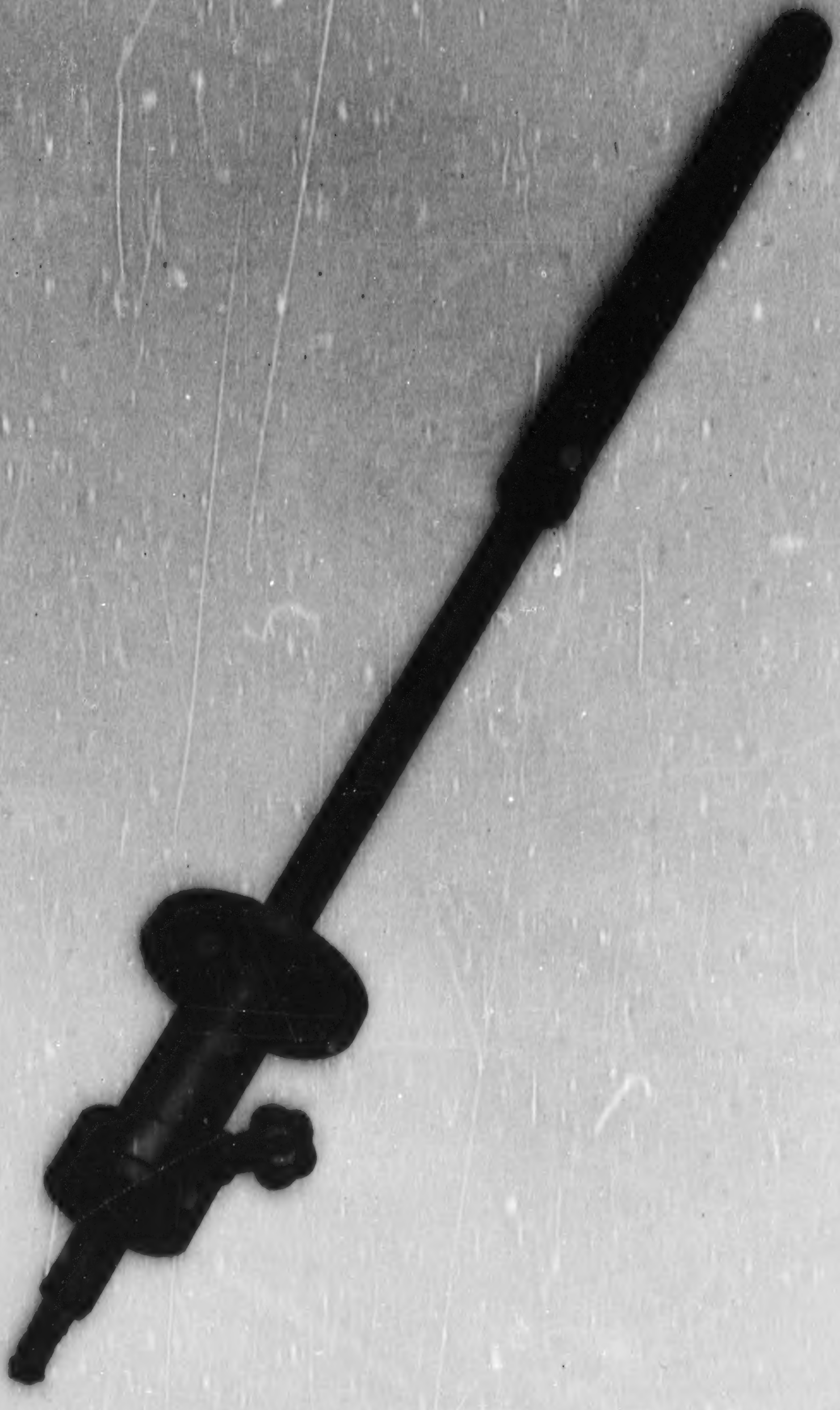
29417-9 Wet Chemical Analysis for SO_2
Sulfur Dioxide Monitor Trailer - Bag Filterhouse
9-22-69 Mercer Generating Station Public Service Electric and Gas Company
Photo 4

INTERTECH MODEL A 5611
AUTOMATIC MONITORING SYSTEM
For SO_2 IN STACK GAS

Photo 5

INTERTECH URAS-2
INFRARED GAS ANALYZER

Photo 6



INTERTECH HEATED SAMPLING PROBE
FOR HIGH DUST LOAD CONDITIONS
USED FOR SAMPLING BEFORE BAGHOUSE

Photo 7

29417-5 Additive Distribution Manifold

Bag Filterhouse

9-22-69 Mercer Generating Station Public Service Electric and Gas Company

Photo 8

29417-6 Collecting Ash and Additive

Bag Filterhouse

9-22-69 Mercer Generating Station Public Service Electric and Gas Company

Photo 9

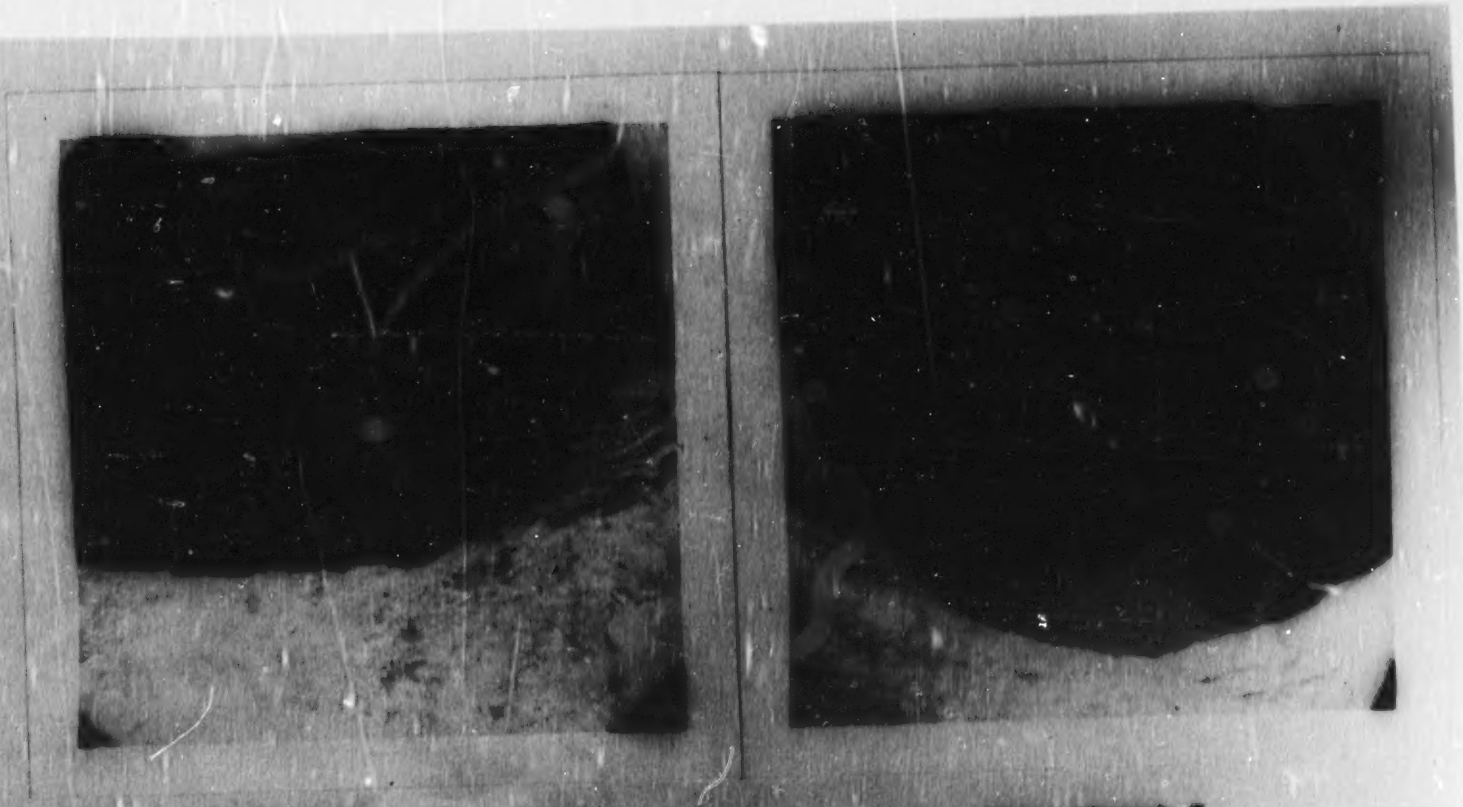
29417-8 **Weighing of Collection Cart**

Bag Filterhouse

9-22-69 Mercer Generating Station Public Service Electric and Gas Company

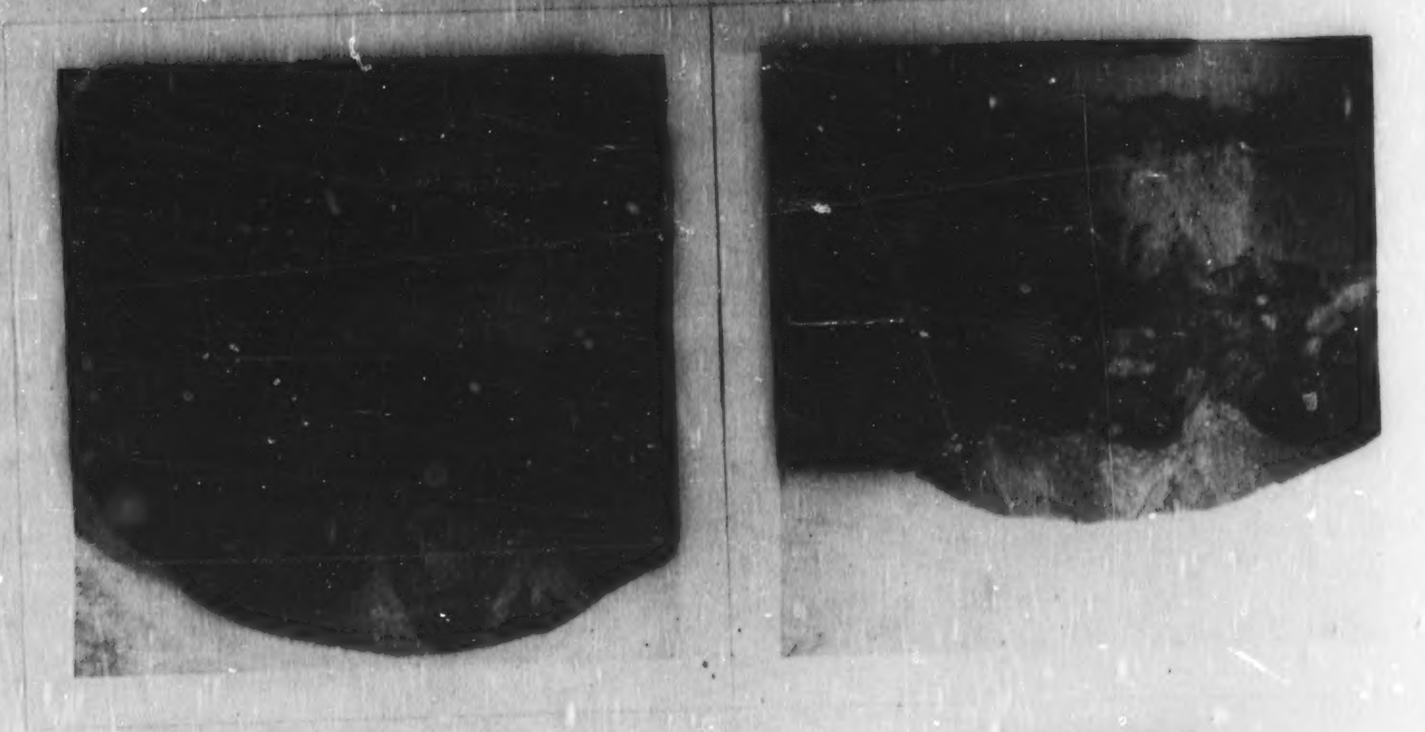
Photo 10

29417-7 Collecting Sample from Deflation Fan Discharge
Bag Filterhouse
9-22-69 Mercer Generating Station Public Service Electric and Gas Company
Photo 11



Compartment B

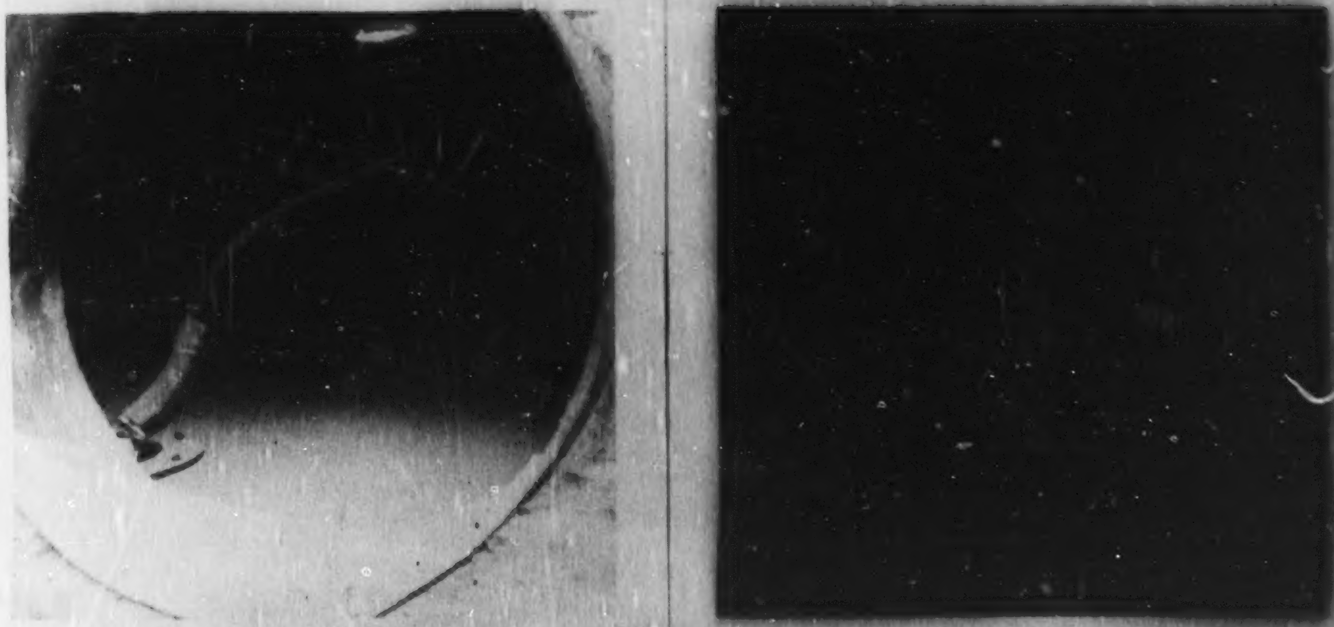
Compartment C



Compartment A

Compartment D

Photo 12



Upper Plenum
Additive Distribution

Access Door Comp. D
Lime Operation

Bag Pulled Loose
Compartment D

Top of
Lower Tube Sheet

Photo 13

[illegible] Bag Filterhouse

29107 NO_x Sampling at Outlet Bag Filterhouse

6-5-69 Mercer Generating Station Public Service Electric and Gas Company

Photo 14

29417-2 Control Panel - Bag Filterhouse

9-22-69 Mercer Generating Station Public Service Electric and Gas Company

Photo 15